



Electrical Design Manual for

- *New Hospitals*
- *Replacement Hospitals*
- *Ambulatory Care*
- *Clinical Additions*
- *Energy Centers*
- *Outpatient Clinics*
- *Animal Research Facilities*
- *Laboratory Buildings*

Department of Veterans Affairs

Office of Construction & Facilities Management
Facilities Quality Service (00CFM1A)
811 Vermont Avenue, NW
Washington DC 20420



CHAPTER 1: GENERAL REQUIREMENTS

1.1	PURPOSE	1-3
1.2	RESPONSIBILITY	1-3
1.3	AUTHORITY HAVING JURISDICTION.....	1-3
1.4	COORDINATION	1-3
1.5	VA DESIGN CRITERIA	1-4
1.5.1	MASTER SPECIFICATIONS (PG-18-1).....	1-4
1.5.2	DESIGN AND CONSTRUCTION PROCEDURES (PG-18-3).....	1-4
1.5.3	NATIONAL CAD STANDARD, VHA APPLICATION GUIDE & STANDARD DETAILS (PG-18-4)	1-5
1.5.4	EQUIPMENT REFERENCE MANUAL (PG-18-6).....	1-5
1.5.5	DESIGN MANUALS (PG-18-10)	1-5
1.5.6	DESIGN GUIDES (PG-18-12).....	1-6
1.5.7	DESIGN SUBMISSION REQUIREMENTS (PG-18-15)	1-6
1.5.8	ARCHITECT/ENGINEER REVIEW CHECKLIST	1-6
1.5.9	DESIGN ALERTS.....	1-7
1.5.10	QUALITY ALERTS	1-7
1.5.11	PHYSICAL SECURITY DESIGN MANUAL FOR VA FACILITIES MISSION CRITICAL FACILITIES & LIFE SAFETY PROTECTED FACILITIES	1-7
1.5.12	COST ESTIMATING MANUAL.....	1-8
1.5.13	SUSTAINABLE DESIGN AND ENERGY REDUCTION MANUAL.....	1-8
1.5.14	SEISMIC DESIGN REQUIREMENTS (H-18-8).....	1-8
1.5.15	FIRE PROTECTION DESIGN MANUAL.....	1-8
1.5.16	VA HOSPITAL BUILDING SYSTEM.....	1-9
1.5.17	COMPUTER AIDED FACILITIES MANAGEMENT REQUIREMENTS (CAFM).....	1-9
1.6	OTHER DESIGN CRITERIA	1-9
1.6.1	ENERGY CONSERVATION.....	1-9
1.6.2	DOE INTERIM FINAL RULE	1-9
1.6.2.1	ASHRAE Standard 90.1 – 2004	1-10
1.6.2.2	Additional Mandated Energy Conservation Measures	1-10
1.6.3	EXECUTIVE ORDER 13423 DATED JANUARY 26, 2007	1-10
1.6.3.1	New Construction	1-11
1.6.3.2	Major Renovations	1-11
1.6.3.3	Additional Measures (MOU)	1-11
1.6.4	COMMISSIONING	1-11
1.6.5	MEASUREMENTS AND VERIFICATION	1-12
1.7	APPLICABLE CODES AND STANDARDS.....	1-12
1.7.1	GENERAL	1-12
1.7.2	LOCAL CODES AND CONDITIONS.....	1-13
1.7.3	LOCAL UTILITY	1-13
1.8	DESIGN REQUIREMENTS.....	1-13
1.9	CRITERIA UNIQUE TO VA.....	1-14
1.9.1	DRAWINGS.....	1-14
1.9.2	SEQUENCE OF ELECTRICAL DRAWINGS	1-15
1.9.3	ABBREVIATIONS AND SYMBOLS.....	1-16
1.9.4	PROPRIETARY ITEMS.....	1-16

1.10	CALCULATIONS	1-16
1.10.1	GENERAL	1-16
1.10.2	FAULT CURRENT CALCULATIONS	1-16
1.10.3	PROTECTIVE DEVICE COORDINATION CALCULATIONS.....	1-17
1.10.4	ARC FLASH CALCULATIONS.....	1-17
1.10.5	LOAD CALCULATIONS	1-17
1.10.6	GENERATOR SIZING CALCULATIONS	1-17
1.10.7	VOLTAGE DROP CALCULATIONS.....	1-17
1.10.8	HARMONIC DISTORTION CALCULATIONS	1-17
1.10.9	LIGHTNING PROTECTIONS CALCULATIONS	1-18
1.10.10	LIGHTING CALCULATIONS	1-18
1.11	SEISMIC BRACING	1-18
1.11.1	REFERENCES.....	1-18
1.11.2	DRAWINGS.....	1-18
1.11.3	EQUIPMENT BRACING.....	1-18
1.12	TRANSPORT SYSTEMS	1-18
1.13	FIRE ALARM SYSTEMS.....	1-18
1.14	RENOVATION TO EXISTING SITES AND BUILDINGS.....	1-18
1.14.1	DRAWINGS.....	1-18
1.14.2	MODIFICATION VERSUS REPLACEMENT.....	1-19
1.14.3	AGE AND PHYSICAL CONDITION	1-19
1.14.4	PARTS AVAILABILITY	1-19
1.14.5	CONDUIT AND JUNCTION BOXES	1-19
1.14.6	CONDUCTORS.....	1-20
1.14.7	WIRING DEVICES	1-20
1.14.8	LIGHTING FIXTURES.....	1-20
1.14.9	PANELBOARDS	1-20
1.14.10	GOVERNMENT RETAINED EQUIPMENT	1-21
1.14.11	CONTINUITY OF SERVICE.....	1-21
1.14.12	COMPATIBILITY	1-21

CHAPTER 2: RACEWAYS, WIRING AND EQUIPMENT

2.1	RACEWAYS.....	2-3
2.1.1	CONCEALED AND EXPOSED	2-3
2.1.2	UNDERGROUND DUCTS AND CONDUITS	2-3
2.1.3	SPARE CONDUITS.....	2-3
2.1.4	UNDERFLOOR DUCT SYSTEMS	2-3
2.1.5	RADIOLOGY ROOMS	2-4
2.1.6	POKE-THRU/POWER POLES	2-4
2.1.7	ETHYLENE OXIDE STERILIZATION AREA.....	2-4
2.2	GROUNDING	2-5
2.2.1	GROUNDING ELECTRODES.....	2-5
2.2.2	EQUIPMENT GROUNDING CONDUCTORS.....	2-5
2.2.3	METAL CURTAIN WALL GROUNDING	2-5
2.3	LIGHTNING PROTECTION SYSTEM.....	2-5
2.4	MOTOR DISCONNECT SWITCHES	2-5

CHAPTER 3: RECEPTACLE AND POWER REQUIREMENTS

3.1	GENERAL	3-3
3.2	ESSENTIAL ELECTRICAL SYSTEM CIRCUITS	3-3
3.3	RECEPTACLE CIRCUITS.....	3-3
3.4	SPECIFIC APPLICATIONS.....	3-3
3.4.1	GROUND FAULT CIRCUIT INTERRUPTER RECEPTACLES.....	3-3
3.4.2	HUMAN SURGERY ROOMS.....	3-3
3.4.3	ICU-CCU FOOT-WALL RECEPTACLES	3-3
3.4.4	EXTERIOR ELECTRICAL RECEPTACLES.....	3-4
3.4.5	WAITING, LOUNGE AND LOBBY AREAS	3-4
3.4.6	ANIMAL SURGERY ROOMS.....	3-4
3.4.7	SELF-ILLUMINATED EMERGENCY RECEPTACLES	3-4
3.4.8	SPECIAL PROCEDURES ROOM – ISOLATED POWER	3-5
3.4.9	CORRIDORS	3-5
3.4.10	KITCHENS	3-5
3.4.11	OFFICES AND ADMINISTRATIVE AREAS	3-5
3.4.12	LABORATORIES AND RESEARCH FACILITIES.....	3-5
3.4.13	PHYSICAL MEDICINE AND REHABILITATION SERVICE	3-5
3.4.14	PSYCHIATRIC PATIENT ROOMS.....	3-6
3.4.15	STAIRWELLS.....	3-6
3.4.16	INTERSTITIAL SPACES	3-6
3.4.17	TV/CCTV POWER RECEPTACLES	3-6
3.4.18	ELECTRICAL CLOSETS	3-6
3.4.19	TELECOMMUNICATIONS ROOMS	3-6
3.4.20	MOTORIZED TREADMILLS	3-6

CHAPTER 4: ESSENTIAL ELECTRICAL POWER SYSTEMS

4.1	GENERAL	4-3
4.2	MIXED ESSENTIAL AND STANDBY ELECTRICAL POWER SYSTEMS...	4-3
4.3	COMMISSIONING	4-3
4.4	EQUIPMENT AND RATINGS.....	4-3
4.4.1	GENERATORS	4-3
4.4.2	AUTOMATIC TRANSFER SWITCHES	4-3
4.4.3	CONTROL NETWORK.....	4-3
4.4.4	DIESEL FUEL STORAGE	4-4
4.4.5	LOCATION	4-4
4.5	EXISTING FACILITIES	4-4
4.6	ESSENTIAL ELECTRICAL SYSTEMS FOR HOSPITALS.....	4-4
4.6.1	ENFORCING CODES	4-4
4.6.1.1	Life Safety Branch	4-4
4.6.1.2	Critical Branch	4-5
4.6.2	EQUIPMENT BRANCH	4-6
4.6.2.1	Equipment Branch Non-Delayed Automatic Connection.....	4-6
4.6.2.2	Equipment Branch Delayed-Automatic Connection	4-6
4.6.3	ALTERNATE SOURCE OF POWER	4-8
4.7	ESSENTIAL ELECTRICAL SYSTEM FOR NURSING HOMES AND LIMITED CARE FACILITIES	4-8

4.7.1	LIFE SAFETY BRANCH.....	4-8
4.7.2	CRITICAL BRANCH.....	4-9
4.7.3	ALTERNATE SOURCE OF POWER	4-9
4.8	ESSENTIAL ELECTRICAL SYSTEM FOR OTHER HEALTHCARE FACILITIES	4-9
4.8.1	TYPE 3 LOADS.....	4-9
4.8.2	ALTERNATE SOURCE OF POWER	4-9
4.9	ESSENTIAL ELECTRICAL SYSTEM FOR OTHER FACILITIES	4-9
4.9.1	BOILER PLANT AND ENERGY BUILDINGS.....	4-9
4.9.2	FIRE STATION.....	4-10
4.10	STANDBY ELECTRICAL SYSTEM FOR MISSION CRITICAL FACILITIES	4-10
4.10.1	REQUIREMENTS	4-10
4.10.2	STANDBY SOURCE OF POWER.....	4-10

CHAPTER 5: ELECTRICAL POWER DISTRIBUTION

5.1	UTILITY SERVICE	5-3
5.2	PRIMARY DISTRIBUTION.....	5-3
5.2.1	GENERAL	5-3
5.2.2	PRIMARY SWITCHGEAR.....	5-3
5.2.3	PRIMARY CABLING	5-4
5.2.4	BUILDING PRIMARY-VOLTAGE DISCONNECTING MEANS.....	5-4
5.3	SECONDARY DISTRIBUTION	5-4
5.3.1	GENERAL	5-4
5.3.2	MEDIUM-TO-LOW VOLTAGE TRANSFORMERS	5-4
5.3.3	LOW VOLTAGE TRANSFORMERS	5-4
5.3.4	SWITCHBOARDS, SWITCHGEAR, AND MOTOR CONTROL CENTERS	5-4
5.3.5	PANELBOARDS	5-5
5.3.6	TRANSIENT VOLTAGE SURGE SUPPRESSION	5-5
5.3.7	LOADS FED FROM UNINTERRUPTIBLE POWER SUPPLY (UPS)	5-5
5.4	POWER MONITORING AND METERING	5-5
5.4.1	GENERAL	5-5
5.4.2	ENERGY CENTERS	5-5
5.4.3	EXISTING FACILITIES	5-6
5.5	ELECTRICAL ROOMS AND CLOSETS	5-6
5.5.1	GENERAL	5-6
5.5.2	SPACE FOR FUTURE EQUIPMENT.....	5-7
5.6	ELECTRICAL FACILITIES FOR OPERATING ROOMS.....	5-7
5.7	ELECTRICAL FACILITIES FOR ELEVATORS.....	5-7

CHAPTER 6: LIGHTING

6.1	GENERAL	6-3
6.2	STANDARDS	6-3
6.3	LIGHTING CALCULATIONS.....	6-3
6.4	LIGHTING FIXTURE SCHEDULE.....	6-3
6.5	DESIGN APPROACH.....	6-3
6.5.1	DEVIATIONS.....	6-3
6.5.2	LIGHTING SCHEMES.....	6-3

6.6	LIGHT SOURCES	6-4
6.6.1	STANDARDIZATION OF SOURCES	6-4
6.6.2	FLUORESCENT	6-4
6.6.3	METAL HALIDE	6-4
6.6.4	LED	6-4
6.7	BALLASTS	6-4
6.8	FIXTURES	6-4
6.9	CONTROL	6-5
6.9.1	GENERAL	6-5
6.9.2	INTERIOR LIGHTING CONTROL	6-5
6.9.3	EXTERIOR LIGHTING CONTROL	6-6
6.10	INTERIOR LIGHTING	6-6
6.10.1	GENERAL	6-6
6.10.2	SPECIFIC APPLICATIONS	6-6
6.10.3	BEDROOM LIGHTING	6-7
6.10.3.1	General Lighting	6-7
6.10.3.2	Bed Lights	6-7
6.10.3.3	Vestibule Lighting	6-8
6.10.3.4	Service Alcove	6-7
6.10.3.5	Bedroom Lavatory	6-8
6.10.3.6	Night Light	6-8
6.10.3.7	Toilet/Bathroom	6-8
6.10.3.8	Closets or Lockers	6-8
6.10.4	CORRIDOR LIGHTING IN NURSING HOMES AND GERIATRIC AREAS (NOT DOMICILIARY)	6-8
6.10.5	EYE EXAMINATION ROOMS	6-8
6.10.6	HEMODIALYSIS EXAM	6-9
6.10.7	INTERSTITIAL SPACES	6-9
6.10.8	KITCHEN HOOD	6-9
6.10.9	POOL LIGHTING	6-10
6.10.10	ANIMAL WARD	6-10
6.10.11	PARKING GARAGES	6-10
6.10.12	ELEVATOR HOISTWAYS	6-10
6.11	EXTERIOR LIGHTING	6-10
6.11.1	GENERAL	6-10
6.11.2	EXISTING SITES	6-11
6.11.3	OBSTRUCTION LIGHTING	6-11
6.11.4	PARKING LOTS	6-11

CHAPTER 7: TELECOMMUNICATIONS CABLE PATHWAYS, WIRING, CABLES, AND INFRASTRUCTURE PLANT; AND SPECIAL TELECOMMUNICATIONS SYSTEMS

7.1	SCOPE	7-3
7.2	GENERAL REQUIREMENTS	7-3
7.2.1	TELECOMMUNICATIONS INFRASTRUCTURE PLANT (TIP)	7-3
7.2.2	TIP FUNCTIONAL REQUIREMENTS	7-4
7.3	CONDUITS AND BOXES	7-4
7.3.1	GENERAL	7-4
7.3.2	MINIMUM SIZE	7-4
7.3.3	INTERCONNECTING CONDUIT REQUIREMENTS	7-4

7.3.4	HORIZONTAL CONDUITS.....	7-6
7.3.5	PARTITIONED CABLE TRAYS AND OPEN WIREWAYS.....	7-6
7.3.6	TELECOMMUNICATIONS CABLE DUCTS UNDER CELLULAR FLOORS.....	7-7
7.3.7	VERTICAL RISERS	7-7
7.4	TELECOMMUNICATIONS OUTLETS	7-7
7.5	DRAWINGS.....	7-8
7.6	WIRES AND CABLES	7-8
7.7	SPECIAL SYSTEMS SPECIFIC REQUIREMENTS.....	7-9
7.7.1	GENERAL	7-9
7.7.2	NURSE CALL	7-9
7.7.3	PUBLIC ADDRESS (PA)	7-9
7.7.4	INTERCOMMUNICATION SYSTEM (IC).....	7-9
7.7.5	MASTER ANTENNA TELEVISION (MATV).....	7-10
7.7.6	MOTION INTRUSION DETECTION (MID).....	7-10
7.7.7	CLOSED CIRCUIT TELEVISION (CCTV).....	7-10
7.7.8	ELECTRONIC ACCESS AND DOOR CONTROL (EADR)	7-10
7.7.9	RADIO PAGING SYSTEM (RPS).....	7-11
7.7.10	PATIENT/STAFF ANNUNCIATOR/LOCATOR SYSTEM (PAL)	7-11
7.7.11	TWO - WAY RADIO SYSTEM.....	7-11
7.7.12	DURESS ALARM AND EMERGENCY NOTIFICATION SYSTEM	7-11
7.7.13	SECURITY MANAGEMENT AND CONTROL, AND CENTRALIZED POLICE SECURITY MANAGEMENT SYSTEMS	7-11
7.7.14	PATIENT ANNUNCIATOR/LOCATOR SYSTEM (PAS)	7-12

CHAPTER 8: TELECOMMUNICATIONS/SPECIAL SYSTEMS ROOMS AND SPACE REQUIREMENTS

8.1	SCOPE.....	8-5
8.2	ROOM TYPES AND DEFINITIONS	8-5
8.2.1	GENERAL	8-5
8.2.2	HEADEND EQUIPMENT (HE) ROOM	8-5
8.2.3	ENTRANCE ROOM (ER OR DMARC).....	8-5
8.2.4	TELEPHONE EQUIPMENT ROOM (TER).....	8-5
8.2.5	TELEPHONE CONSOLE ROOM (TCR)	8-6
8.2.6	MAIN COMPUTER ROOM (MCR)	8-6
8.2.7	TELECOMMUNICATIONS ROOM (TR).....	8-6
8.2.8	POLICE, EMERGENCY, AND DESIGNATED CONTROL ROOMS	8-6
8.3	GENERAL ENVIRONMENTAL, POWER AND SPACE REQUIREMENTS	8-6
8.3.1	GENERAL	8-6
8.3.2	LOCATION, PROTECTION, AND ACCESS	8-6
8.3.3	ROOM ENVELOPE	8-7
8.3.4	HEATING, VENTILATION, AND AIR CONDITIONING	8-7
8.3.5	POWER.....	8-7
8.3.6	LIGHTING	8-8
8.3.7	GROUNDING	8-8
8.3.8	SECURITY	8-8
8.3.9	CABLE AND WIRE PATHWAYS.....	8-8
8.4	HEADEND EQUIPMENT (HE) ROOM	8-9
8.4.1	GENERAL	8-9

8.4.2	LOCATION	8-9
8.4.3	CONFIGURATION	8-9
8.4.4	ROOM ENVELOPE	8-10
8.4.5	TIP WIRE/CABLE INTERFACE AREA.....	8-10
8.4.6	HEATING, VENTILATION, AND AIR CONDITIONING	8-10
8.4.7	FIRE PROTECTION.....	8-10
8.4.8	POWER.....	8-11
8.4.9	LIGHTING	8-11
8.4.10	GROUNDING	8-11
8.4.11	SECURITY	8-11
8.4.12	WIRE MANAGEMENT	8-11
8.5	ENTRANCE ROOM (ER OR DMARC).....	8-12
8.5.1	LOCATION.....	8-12
8.5.2	CONFIGURATION	8-12
8.5.3	FIRE PROTECTION.....	8-12
8.5.4	SECURITY.....	8-12
8.5.5	OTHER REQUIREMENTS.....	8-12
8.6	TELEPHONE EQUIPMENT ROOM (TER).....	8-12
8.6.1	LOCATION	8-12
8.6.2	CONFIGURATION	8-13
8.6.3	ROOM ENVELOPE	8-13
8.6.4	TIP WIRE/CABLE INTERFACE AREA.....	8-14
8.6.5	HEATING, VENTILATION, AND AIR CONDITIONING	8-14
8.6.6	FIRE PROTECTION.....	8-14
8.6.7	POWER.....	8-14
8.6.8	LIGHTING	8-15
8.6.9	GROUNDING	8-15
8.6.9.1	Telecommunications Main Ground Bar	8-15
8.6.10	SECURITY	8-15
8.7	TELEPHONE CONSOLE ROOM.....	8-15
8.7.1	CONFIGURATION/CONSOLES	8-16
8.7.2	HEATING, VENTILATION AND AIR CONDITIONING	8-16
8.7.3	FIRE PROTECTION.....	8-16
8.7.4	POWER.....	8-16
8.7.5	LIGHTING	8-16
8.7.6	ALARM PANELS	8-16
8.8	MAIN COMPUTER ROOM (MCR)	8-16
8.8.1	RELIABILITY	8-16
8.8.2	LOCATION.....	8-17
8.8.3	CONFIGURATION	8-17
8.8.3.1	Area.....	8-17
8.8.3.2	Walls.....	8-18
8.8.3.3	Access Floor (Optional)	8-18
8.8.3.4	Doors.....	8-19
8.8.3.5	Ceiling	8-19
8.8.4	ROOM ENVELOPE	8-20
8.8.5	HEATING VENTILATION, AND AIR CONDITIONING	8-20
8.8.6	FIRE PROTECTION.....	8-20

8.8.7	POWER	8-20
8.8.8	LIGHTING	8-21
8.8.9	GROUNDING	8-21
8.8.10	SECURITY	8-21
8.8.11	WIRE MANAGEMENT	8-22
8.9	TELECOMMUNICATIONS ROOM (TR).....	8-22
8.9.1	CONFIGURATION	8-22
8.9.2	ROOM ENVELOPE	8-22
8.9.3	HEATING, VENTILATION, AND AIR CONDITIONING	8-22
8.9.4	FIRE PROTECTION.....	8-23
8.9.5	POWER.....	8-23
8.9.6	LIGHTING	8-23
8.9.7	GROUNDING	8-23
8.9.8	SECURITY	8-23
8.9.9	WIRE MANAGEMENT	8-23
8.10	REMOTE OR SECONDARY TELECOMMUNICATIONS ROOM	8-23
8.10.1	LOCATION	8-23
8.10.2	CONFIGURATION	8-24
8.10.3	ROOM ENVELOPE	8-24
8.10.4	HEATING, VENTILATION, AND AIR CONDITIONING	8-24
8.10.5	FIRE PROTECTION.....	8-24
8.10.6	POWER.....	8-24
8.10.7	LIGHTING	8-24
8.10.8	GROUNDING	8-24
8.10.9	SECURITY	8-24
8.10.10	WIRE MANAGEMENT	8-24
8.11	TERMINAL CABINETS	8-24
8.12	POLICE, ENGINEERING AND OTHER DESIGNATED CONTROL ROOM(S)	8-25

CHAPTER 9: SPECIAL MEDICAL AND ALARM SYSTEMS

9.1	GENERAL	9-3
9.2	PATIENT WALL SYSTEMS	9-3
9.3	PREFABRICATED BEDSIDE PATIENT UNIT (PBPU).....	9-3
9.3.1	PBPU INSTALLATION	9-3
9.3.2	PBPU APPLICATION.....	9-4
9.4	MEDICAL GAS, VACUUM AND AIR ALARM SYSTEM.....	9-5

APPENDIX A – ILLUMINATION LEVELS

APPENDIX B - DRAWINGS

INDEX

Blue indicates links. Chapters or various sections in chapters will open upon clicking of these links.

CHAPTER 1: GENERAL REQUIREMENTS

1.1	PURPOSE	1-3
1.2	RESPONSIBILITY	1-3
1.3	AUTHORITY HAVING JURISDICTION.....	1-3
1.4	COORDINATION	1-3
1.5	VA DESIGN CRITERIA	1-4
1.5.1	MASTER SPECIFICATIONS (PG-18-1).....	1-4
1.5.2	DESIGN AND CONSTRUCTION PROCEDURES (PG-18-3).....	1-4
1.5.3	NATIONAL CAD STANDARD, VHA APPLICATION GUIDE & STANDARD DETAILS (PG-18-4)	1-5
1.5.4	EQUIPMENT REFERENCE MANUAL (PG-18-6).....	1-5
1.5.5	DESIGN MANUALS (PG-18-10)	1-5
1.5.6	DESIGN GUIDES (PG-18-12).....	1-6
1.5.7	DESIGN SUBMISSION REQUIREMENTS (PG-18-15)	1-6
1.5.8	ARCHITECT/ENGINEER REVIEW CHECKLIST	1-6
1.5.9	DESIGN ALERTS.....	1-7
1.5.10	QUALITY ALERTS	1-7
1.5.11	PHYSICAL SECURITY DESIGN MANUAL FOR VA FACILITIES MISSION CRITICAL FACILITIES & LIFE SAFETY PROTECTED FACILITIES	1-7
1.5.12	COST ESTIMATING MANUAL.....	1-8
1.5.13	SUSTAINABLE DESIGN AND ENERGY REDUCTION MANUAL.....	1-8
1.5.14	SEISMIC DESIGN REQUIREMENTS (H-18-8).....	1-8
1.5.15	FIRE PROTECTION DESIGN MANUAL.....	1-8
1.5.16	VA HOSPITAL BUILDING SYSTEM.....	1-9
1.5.17	COMPUTER AIDED FACILITIES MANAGEMENT REQUIREMENTS (CAFM)	1-9
1.6	OTHER DESIGN CRITERIA	1-9
1.6.1	ENERGY CONSERVATION.....	1-9
1.6.2	DOE INTERIM FINAL RULE	1-9
1.6.2.1	ASHRAE Standard 90.1 – 2004	1-10
1.6.2.2	Additional Mandated Energy Conservation Measures	1-10
1.6.3	EXECUTIVE ORDER 13423 DATED JANUARY 26, 2007	1-10
1.6.3.1	New Construction	1-11
1.6.3.2	Major Renovations	1-11
1.6.3.3	Additional Measures (MOU)	1-11
1.6.4	COMMISSIONING	1-11
1.6.5	MEASUREMENTS AND VERIFICATION	1-12
1.7	APPLICABLE CODES AND STANDARDS.....	1-12
1.7.1	GENERAL	1-12
1.7.2	LOCAL CODES AND CONDITIONS.....	1-13
1.7.3	LOCAL UTILITY	1-13
1.8	DESIGN REQUIREMENTS.....	1-13
1.9	CRITERIA UNIQUE TO VA.....	1-14
1.9.1	DRAWINGS.....	1-14
1.9.2	SEQUENCE OF ELECTRICAL DRAWINGS	1-15
1.9.3	ABBREVIATIONS AND SYMBOLS.....	1-16
1.10.2	FAULT CURRENT CALCULATIONS.....	1-16
1.10.3	PROTECTIVE DEVICE COORDINATION CALCULATIONS.....	1-17
1.10.4	ARC FLASH CALCULATIONS.....	1-17

CHAPTER 1: GENERAL REQUIREMENTS

1.10.5	LOAD CALCULATIONS	1-17
1.10.6	GENERATOR SIZING CALCULATIONS	1-17
1.10.7	VOLTAGE DROP CALCULATIONS.....	1-17
1.10.8	HARMONIC DISTORTION CALCULATIONS	1-17
1.10.9	LIGHTNING PROTECTIONS CALCULATIONS	1-18
1.10.10	LIGHTING CALCULATIONS	1-18
1.11	SEISMIC BRACING	1-18
1.11.1	REFERENCES.....	1-18
1.11.2	DRAWINGS.....	1-18
1.11.3	EQUIPMENT BRACING.....	1-18
1.12	TRANSPORT SYSTEMS	1-18
1.13	FIRE ALARM SYSTEMS.....	1-18
1.14	RENOVATION TO EXISTING SITES AND BUILDINGS.....	1-18
1.14.1	DRAWINGS.....	1-18
1.14.2	MODIFICATION VERSUS REPLACEMENT.....	1-19
1.14.3	AGE AND PHYSICAL CONDITION	1-19
1.14.4	PARTS AVAILABILITY	1-19
1.14.5	CONDUIT AND JUNCTION BOXES	1-19
1.14.6	CONDUCTORS.....	1-20
1.14.7	WIRING DEVICES	1-20
1.14.8	LIGHTING FIXTURES.....	1-20
1.14.9	PANELBOARDS	1-20
1.14.10	GOVERNMENT RETAINED EQUIPMENT	1-21
1.14.11	CONTINUITY OF SERVICE	1-21
1.14.12	COMPATIBILITY	1-21

1.1 PURPOSE

This manual is a guide for electrical and telecommunications engineers and designers (hereafter referred as A/E) for the planning and design of the electrical power distribution, lighting, signal, telecommunications, and related systems (hereinafter referred to as systems) at Department of Veterans Affairs (VA) facilities.

It is expected that systems designed with the use of this Manual will meet their primary objective of providing a safe, reliable, and energy efficient installation. In order to provide the latitude needed for new technologies and concepts, technical deviations from the stipulations of this manual may be made only if a safe, reliable and energy efficient design will be the result. Such deviations must be approved by the VA. Deviations are not permitted from those requirements included in public laws, federal regulations, executive orders, and all applicable codes.

1.2 RESPONSIBILITY

The A/E shall provide all necessary professional services to perform planning and design of the systems for the project. The A/E is responsible and liable for the professional design in accordance with the contract, good engineering practices, VA standards, VA project-specific requirements if any, and applicable codes.

1.3 AUTHORITY HAVING JURISDICTION

Unless otherwise directed by VA, the Authority Having Jurisdiction is the VISN Safety Officer.

1.4 COORDINATION

(a) The A/E shall coordinate planning and design work with the architectural, structural, civil, site, sanitary, mechanical, fire protection, and LEED/Sustainable designs as applicable. Of particular focus shall be concealed and underground areas, and site utility coordination. Provide adjustable frequency drives for motors as required on the mechanical drawings; provide branch circuit power to terminal units, terminal unit fans, smoke dampers, control panels, and other auxiliaries; and provide fire alarm design as required for the mechanical systems.

(b) Utility Coordination:

- (1)** For projects requiring new electrical or telecommunications service, the A/E shall coordinate requirements with the local utility. The Contractor's scope of work, as it relates to the service, shall be detailed in the Construction Documents. The A/E shall forward copies of all correspondence and minutes of meetings with the utility company's representatives to the Project Manager for negotiations for new services or making changes to the existing services.
- (2)** For renovations of and/or additions to existing buildings, the A/E shall investigate the existing electrical service/distribution system and determine if sufficient capacity is available to accommodate the new loads. If applicable, the A/E shall inform the electric utility company of the new service requirements and additional loads.
- (3)** Major site distribution components, such as medium voltage and low voltage power feeders, ductbanks, and manholes, shall be shown on the civil utility plans for coordination purposes.

(c) Pre-Design Site Survey: For renovations of and/or additions to existing buildings, the A/E shall perform the following tasks:

1. **Electrical Load Monitoring:** Investigate the existing electrical service/distribution system and determine if sufficient capacity is available to accommodate the new loads. Meter readings are required per NEC.
2. **Existing Electrical Installation:** Investigate all existing electrical installations such as existing concealed conduit runs, conduit types/sizes, cable types/sizes, panelboard types/sizes, electrical equipment locations, etc., which potentially impact the new installation.

1.5 VA DESIGN CRITERIA

Pertinent standards of VA's Office of Construction and Facilities Management Technical Information Library (TIL). Some of the major standards are:

1.5.1 MASTER SPECIFICATIONS (PG-18-1)

Located in Technical Information Library

<http://www.cfm.va.gov/TIL/spec.asp>

Purpose

Defines a standardized method for the A/E to assure that the contractor provides equipment and systems that meet the design intent in terms of performance, quality and cost

The Specifications accomplish this by:

- Providing specific narrative descriptions of required equipment, salient elements, and system construction
- Listing applicable standards and codes and references
- Requiring individual submittal of equipment and systems for review and approval prior to contractor purchase
- Defining specific installation methods to be used

1.5.2 DESIGN AND CONSTRUCTION PROCEDURES (PG-18-3)

Located in Technical Information Library

<http://www.cfm.va.gov/TIL/cPro.asp>

Purpose

Establishes minimum consistent design/construction practices

The Procedures section accomplishes this by:

- Referencing applicable codes and policies
- Describing standard drawing formats
- Listing security strategies
- Including miscellaneous design details

1.5.3 NATIONAL CAD STANDARD, VHA APPLICATION GUIDE & STANDARD DETAILS (PG-18-4)

Located in Technical Information Library

<http://www.cfm.va.gov/TIL/sDetail.asp>

Purpose

VHA Application Guide adopts the NIBS National CAD Standard, establishes VA-specific drafting standards for the preparation of design and construction documents, provides utility and sheet template files and standard construction details organized by discipline, for use in design and construction documents for VA projects.

1.5.4 EQUIPMENT REFERENCE MANUAL (PG-18-5)

Located in Technical Information Library

<http://www.cfm.va.gov/TIL/equip.asp>

Purpose

Information for planning and developing requirements for contractor purchased and installed equipment for VA construction projects.

1.5.5 DESIGN MANUALS (PG-18-10)

Located in Technical Information Library

<http://www.cfm.va.gov/til/dManual.asp>

Purpose

To convey the general and specific VA design philosophy for medical and support facilities

The Manuals accomplish this purpose by:

- Explaining specific design methodologies
- Listing acceptable system types
- Setting the overall energy consumption target
- Codifying certain code interpretations
- Listing values for design parameters
- Referencing certain sections of the Master Specification and Standard Details
- Containing examples of certain design elements

Note: The A/E shall submit to VA a list of Design Manuals along with the TIL posted dates that were in effect on date of contract award.

1.5.6 DESIGN GUIDES (PG-18-12)

Located in Technical Information Library

<http://www.cfm.va.gov/til/dGuide.asp>

Purpose

Provides the A/E with specific layout templates and medical equipment lists for all types of spaces/uses, and specific design parameters for structural, electrical and mechanical service

The Design Guides accomplish this by:

- Publishing design narrative
- Including functional diagrams and layout plates
- Listing standards

1.5.7 DESIGN SUBMISSION REQUIREMENTS (PG-18-15)

Located in Architect/Engineer Information

<http://www.cfm.va.gov/contract/aeDesSubReq.asp>

Purpose

To provide a staged listing of tasks in various design categories as a way to define the A/E scope in order to assure thorough and timely completion of the final design package and bid documents

The Instructions accomplishes this purpose by:

- Progressively listing tasks as Schematic, Design Development and Construction Documents stages
- Requiring task completion and submission for each stage according to a Critical Path Method (CPM) calendar
- Implementation of a QA/QC process to assure a quality design product
- Requiring life cycle analysis of alternatives in order to optimize the design/cost tradeoff
- Listing and detailing all the drawings, calculations and specifications required for a complete design package
- Indicating the final distribution of bid documents

1.5.8 ARCHITECT/ENGINEER REVIEW CHECKLIST

Located in Technical Information Library

<http://www.cfm.va.gov/til/projReq.asp>

Purpose

Provides the VA Peer Reviewer with a minimum list of critical items, which must be included in each A/E submission

The Checklist accomplishes this by:

- Referring to all applicable VA design tools which apply to the specific project
- Detailing certain Life Safety and coordination requirements

1.5.9 DESIGN ALERTS

Located in Technical Information Library

<http://www.cfm.va.gov/til/alert.asp>

Purpose

Communicates current design issues and solutions

The Design Alerts accomplish this by:

- Publishing periodic alert memos
- Summarizing design solutions

1.5.10 QUALITY ALERTS

Located in Technical Information Library

<http://www.cfm.va.gov/til/alert.asp#qalert>

Purpose

Communicates quality deficiencies from recent A/E design submissions

The Quality Alerts accomplish this by:

- Publishing checklists of design details often missed
- Including references to technical resources

1.5.11 PHYSICAL SECURITY DESIGN MANUAL FOR VA FACILITIES - MISSION CRITICAL FACILITIES & LIFE SAFETY PROTECTED FACILITIES

Located in Technical Information Library

<http://www.cfm.va.gov/til/spclRqmts.asp#PHS>

Purpose

Sets physical security standards for facilities required to continue operation during a natural or man-made extreme event and for facilities that are required to protect the life safety of patients and staff in an emergency

The Manuals accomplish this by:

- Sets objectives for physical security
- Provides strategies for use in design and construction to provide protection to VA facilities
- Provides cost effective design criteria

1.5.12 COST ESTIMATING MANUAL

Located in Technical Information Library

<http://www.cfm.va.gov/cost/>

Purpose

To convey the general and specific VA cost estimating philosophy for medical facilities

The Manual accomplishes this by:

- Explaining specific estimating methodologies
- Containing examples of certain design elements

1.5.13 SUSTAINABLE DESIGN AND ENERGY REDUCTION MANUAL

Located in Technical Information Library

<http://www.cfm.va.gov/til/sustain.asp>

Purpose

This manual identifies the seven sustainability goals outlined in the Federal Mandates, and maps each goal to the appropriate LEED strategy for implementation. Methods for consideration to achieve the goals, budget considerations, case studies, and checklists are also included.

The Manual accomplishes this by:

- Prescribing the use of integrated design practices
- Provides strategies for optimization of energy performance
- Provides strategies for protection and conservation of water resources
- Provides strategies for enhancement of indoor environmental quality
- Provides strategies for reduction of environmental impact of materials

1.5.14 SEISMIC DESIGN REQUIREMENTS (H-18-8)

Located in Technical Information Library

<http://www.va.gov/facmgt/standard/seismic.asp>

Purpose

Policies established to insure that all new and existing VA hospital facilities in seismic areas are designed to remain operational after an earthquake.

1.5.15 FIRE PROTECTION DESIGN MANUAL

Located in Technical Information Library

<http://www.cfm.va.gov/til/spclRqmts.asp#FS>

Purpose

Provides fire protection design criteria, including fire alarm requirements.

1.5.16 VA HOSPITAL BUILDING SYSTEM

The VA Hospital Building System (VAHBS) is a methodology based on a modular concept for planning, designing and constructing hospitals.

The methodology has been used nationwide with success in capital and operating cost containment, shortened delivery schedules and improved space utilization flexibility. All new and replacement VA hospital buildings should use the VAHBS system. Also consider using this system for major additions to existing hospitals where future adaptability is an important factor.

The A/E will find that systems schematic/design development efforts will occur much earlier in the overall planning/design process, due to the modular concept. Equipment selection and main distribution sizing should be evaluated as soon as the size and number of modules is determined.

See VHA Program Guide PG-18-3, Design and Construction Procedures, Topic 3, VA Hospital Building System for further guidance. The complete reference for the VAHBS is contained in the 1976 Development Study (called the Redbook) and the 2006 Supplement.

1.5.17 COMPUTER AIDED FACILITIES MANAGEMENT REQUIREMENTS (CAFM)

VA intends to implement Computer Aided Facility Management (CAFM) systems in all new and replacement hospital construction, and in all existing hospitals as feasible. The CAFM concept requires that all pertinent data regarding a facility be contained in a master digital database, accessible by facilities personnel at their workstations for use in operations, energy/cost management, and maintenance and for planning modifications in facility infrastructure due to space utilization changes.

1.6 OTHER DESIGN CRITERIA

1.6.1 ENERGY CONSERVATION

The need to conserve energy is mandated by the Federal Government by Executive Order and by Law enacted by Congress. In addition, 19 Federal Agencies have signed a Memorandum of Understanding (MOU) outlining specific goals and targets for energy conservation and sustainable design. VA is one of the signatory agencies. In the following paragraphs, references and details of various requirements are given.

1.6.2 DOE INTERIM FINAL RULE

In the Federal Register (Volume 71, No. 232) dated December 4, 2006, the Department of Energy (DOE) issued mandatory energy conservation guidelines, as the interim final rule for implementing provisions in the Energy Policy Act (EPACT 2005). Provisions of the interim final rule are as follows:

1.6.2.1 ASHRAE STANDARD 90.1 - 2004

Lighting systems shall be designed to comply with the ANSI/ASHRAE/IESNA Standard 90.1 – 2004 for Buildings except Low-Rise Residential Buildings. This Standard is a component of the DOE *interim final rule*. By reference, DOE has incorporated Standard 90.1-2004 into 10 CFR Part 433. Also, the US Congress has prescribed this standard in Section 109 of the Energy Policy Act of 2005 (EPACT). Provisions of this standard are mandatory and are not repeated here to avoid duplication. However, at appropriate places in the text, this standard is referred.

The A/E is expected to fully comprehend and implement the practices dictated in ASHRAE 90.1 – 2004.

1.6.2.2 ADDITIONAL MANDATED ENERGY CONSERVATION MEASURES

In addition to complying with the ASHRAE Standard, DOE has mandated that a new Federal building must be designed to achieve an energy consumption level that is at least 30 percent below the level achieved under Standard 90.1-2004, if life-cycle cost effective. Use the Performance Rating Method – Appendix G of ASHRAE Standard 90.1 - 2004.

- (a) **Life-Cycle Cost (LCC) Analysis (Requirements):** If additional 30 percent reduction in energy consumption is not lifecycle cost effective, the A/E must evaluate alternate designs; at successive decrements (say 25 percent, 20 percent, or lower) in order to identify the most energy efficient design that is lifecycle cost-effective. And, in so doing, all readily available energy conservation measures, with which the industry is generally familiar, will be considered and evaluated.

DOE further stipulates that the “agencies must estimate the life-cycle costs and energy consumption of the planned building as designed and an otherwise building just meeting the minimum criteria set forth in the baseline ASHRAE Standard”. This measure is meant to demonstrate and record the mandated compliance and the extent of it.

- (b) **Life-Cycle Cost Analysis (Methodology):** To comply with the Public Law 95-619, an engineering economic analysis shall be performed in accordance with the procedure outlined by the Department of Energy (DOE) in the National Institute of Standards and Technology (NIST) Handbook 135 dated February 1996 (or the latest version) - Life Cycle Costing Manual for the Federal Energy Management Program.

Use the following parameters when performing the analysis:

- 20 year life cycle period for system comparison
- Other features are:
 - 7 percent discount factor
 - No taxes or insurance, while computing cost

1.6.3 EXECUTIVE ORDER 13423 DATED JANUARY 26, 2007

Mandatory energy conservation requirements are also published in the above Executive Order. The MOU is mentioned in Section 2, paragraph f of the Executive Order. The MOU was signed under the Federal Leadership in High Performance and Sustainable Buildings.

The stated goals and objectives of the MOU are as follows:

1.6.3.1 NEW CONSTRUCTION

For new construction, reduce the energy cost budget by 30 percent compared to the baseline performance rating of ASHRAE Standard 90.1 - 2004. This requirement is identical to the interim rule published in the Federal Register.

VA Policy

Reduction in the lighting energy cost budget shall be implemented as the reduction in energy consumption measured as volt-amperes (VA).

1.6.3.2 MAJOR RENOVATIONS

For major renovations, reduce the energy cost budget by 20 percent below pre-renovations 2003 baseline. In the event pre-renovation 2003 baseline data is not available, the A/E shall calculate the lighting energy consumption before renovation, compare it with the energy consumption after renovation, and document the mandated saving. It is assumed that the use of the facility shall remain similar before and after the renovation. A project classified as "major renovation" shall meet the following two criteria:

- (a) For a facility selected for renovation, the area of renovation is greater than 50% of the total area.
- (b) A project is planned that significantly extends the building's useful life through alterations or repairs and totals more than 30% of the replacement value of the facility.

VA Policy

Reduction in the lighting energy cost budget shall be implemented as the reduction in energy consumption measured as volt-amperes (VA).

1.6.3.3 ADDITIONAL MEASURES (MOU)

MOU also addresses related issues, such as commissioning and measurement and verification. These issues are described below.

1.6.4 COMMISSIONING

Employ total building commissioning practices tailored to the size and complexity of the building and its system components in order to verify performance of building components and systems and help ensure that design requirements are met. This should include a designated commissioning authority, inclusion of commissioning requirements in construction documents, a commissioning plan, verification of the installation and performance of systems to be commissioned, and a commissioning report.

1.6.5 MEASUREMENTS AND VERIFICATION

Per DOE Guidelines issued under Section 103 of EPACKT, install building level utility meters in new major construction and renovation projects to track and continuously optimize performance. MOU mandates that the actual performance data from the first year of operation should be compared with the energy design target. After one year of occupancy, measure all new major installations using the Energy Star® Benchmarking Tool for building and space types covered by ENERGY STAR® or FEMP designated equipment.

1.7 APPLICABLE CODES AND STANDARDS

1.7.1 GENERAL

Use the latest edition of Codes, Regulations and Standards as a basis of design. Refer to PG-18-3, Topic 1, Codes, Standards, and Executive Orders. Unless otherwise indicated by VA criteria, use the Codes and Standards of the following organizations:

- (a)** American National Standards Institute (ANSI)
- (b)** American Society for Testing Materials (ASTM)
- (c)** Building Industry Consulting Service International (BICSI)
- (d)** Federal Communications Commission (FCC), all Regulations, Procedures and Standards for Two-Way Radio Equipment, Systems and Operation
- (e)** Illuminating Engineering Society of North America (IESNA)
- (f)** Institute of Electrical and Electronic Engineers (IEEE)
- (g)** International Organization for Standardization (ISO), Standards for Protocols and Interfaces that include Open System Interconnections (OSI)
- (h)** Joint Commission on Accreditation of Healthcare Organizations (JACHO), Environment of Care Guidelines and Standards
- (i)** National Fire Protection Association (NFPA): A/E shall pay particular attention to the following publications:
 - NFPA 20 – Standard for the Installation of Stationary Pumps for Fire Protection
 - NFPA 70 – National Electrical Code
 - NFPA 70 E – Standard for Electrical Safety Requirements for Employee Workplaces
 - NFPA 72 – National Fire Alarm Code
 - NFPA 75 – Standard for the Protection of Electronic Computer/Data Processing Equipment
 - NFPA 77 – Recommended Practice on Static Electricity
 - NFPA 99 – Standard for Health Care Facilities

- NFPA 101 – Life Safety Code
 - NFPA 110 – Standard for Emergency and Standby Power Systems
 - NFPA 780 – Standard for the Installation of Lightning Protection Systems
- (j) National Electrical Manufacturers Association (NEMA)
- (k) Underwriters' Laboratories, Inc. (UL)
- (l) Telecommunications Industry Association and Electronic Alliance Standards Association (EIA/TIA) 568 and/or 569A, Communications Cabling Circuits and Equipment
- (m) Building Industry Consulting Service International, Inc. (BICSI): A/E shall pay particular attention to the following publications:
- Outside Plant Design Reference Manual
 - Telecommunications Distribution Methods Manual
 - Network Design Reference Manual
- (n) ANSI/TIA/EIA-942 – Telecommunications Infrastructure Design for Data Centers.
- (o) United States Department of Commerce, National Telecommunications and Information Administration (NTIA), Manual of Regulations and Procedures for Federal Radio Frequency Management for all Two-Way Radio and Radio Paging Systems, all Narrow-Band and Frequency Use Standards

1.7.2 LOCAL CODES AND CONDITIONS

The A/E shall bring local and regional climatic and geographic conditions, and provisions of local building codes that are significantly different from the codes and standards listed above to the attention of VA and shall provide specific information on how the proposed design will reflect these conditions and codes. Of particular focus shall be local codes, code amendments, and/or conditions related to coastal, hurricane-prone, arctic, or seismically active regions, or other climatic or regional conditions that warrant additional measures to protect the integrity of systems.

1.7.3 LOCAL UTILITY

The A/E shall follow the rules and regulations of the local electric company, where applicable. The A/E shall investigate potential rebates, etc., offered by the local electric company for the use of energy saving equipment.

1.8 DESIGN REQUIREMENTS

- (a) All conductors, all transformer windings, and all bussing in electrical power distribution system components shall be copper.
- (b) Motors rated 1/2 HP and higher shall be 3-phase. Design and specifications shall be based upon 200 V (volt) motors for 208 V systems and 460 V motors for 480 V systems.

- (c) Provide detailed schedules for switchgear, switchboards, panelboards and motor control centers on the drawings. At a minimum, the schedules shall indicate equipment ratings, enclosure type, load descriptions, interrupting ratings, breaker/starter sizes, and connected and demand loads in kVA by phase. The A/E shall determine probable equipment sizes from several manufacturers, and ascertain that the electrical rooms are sufficiently sized. Consider largest and/or heaviest dimensions and weights so that working clearance requirements, space for future installations, and structural requirements are satisfied.
- (d) Specifications:
 - VA Master Specifications have been developed for typical electrical work. The appropriate sections shall be edited to meet the project scope of work and specific project requirements.
 - The A/E shall carefully coordinate specifications with the drawings so that all work required by the drawings is included in the specifications. Specification content that does not apply to the project shall be deleted.
 - The A/E shall develop specifications for any system or equipment not addressed by the VA Master Specifications.

1.9 CRITERIA UNIQUE TO VA

1.9.1 DRAWINGS

- (a) Refer to VA Design and Construction Procedures (PG-18-3), Topic 2 – Drawings, and the VA NCS Application Guide, for general drawing requirements.
- (b) Consolidate notes and place them on the right-hand side of the sheet.
- (c) Show scale, compass point, orientation, key plan, title, column grids and numbers, matchlines, room numbers and titles corresponding to the Architectural drawings.
- (d) Provide large-scale (minimum 1/4"=1'-0") partial plans for areas such as Electrical Rooms, Generator Rooms, Main Computer Room, Telephone Equipment Room, Telecommunications Rooms and Mechanical Equipment Rooms.
- (e) It is mandatory to show the number of wires in each branch circuit conduit on the plans. Include the number of wires in all interconnecting conduits for all wiring devices, fixtures and equipment.
- (f) Provide 1/4-inch scale details of special equipment spaces, such as Laboratories, Radiology, Dietetic Areas, Surgical Rooms, Electrical Rooms, and Telecommunications Rooms.
- (g) Conduit runs for all feeder circuits shall be shown on plans as close to the location of final installations as possible to avoid field installation conflicts which are likely to cause costly construction change orders and delays. These conduit runs shall be shown to run in

parallel with the building outline, and be coordinated with existing field conditions and new installations of electrical and other systems. These conduit runs shall have the appropriate number of pullboxes located at appropriate distances to facilitate efficient installation and maintenance.

- (h) Branch circuit homeruns shall not have more than three circuits. Combining circuits is prohibited.
- (i) At a minimum, the construction documents shall contain diagrams of the following systems:
 - Essential Electrical System Distribution (Riser Diagram); Essential Electrical System Controls and Operation (Riser Diagram); Sequences of Operation
 - Fire Alarm System (Riser Diagram) (note that fire alarm system is to be shown on the Fire Protection drawings; refer to PG-18-15 for more information)
 - Ground Sensing System for Secondary Breakers (480 volt Systems only)
 - Primary Service and System Distribution (One-line Diagram)
 - Grounding Systems and components, including but not limited to grounding electrodes, grounding electrode conductors, grounded conductors, ground bus, bonding jumpers, equipment grounding conductors, for the medium/low voltage service switchgears/switchboards to the low voltage distribution panels (One-line Diagram).
 - Secondary System Distribution (Riser Diagram)
 - Grounding Riser Diagram for Essential and Normal Power Systems
 - Protective Relaying System, Power Monitoring and Control System (One-line Diagram)
 - Telephone, Data, Nurse Call, MATV, CCTV, Intrusion Detection, Access Control, and Other Signal Systems (Riser Diagrams)

1.9.2 SEQUENCE OF ELECTRICAL DRAWINGS

- Symbols and Abbreviations
- Demolition Plans
- Electrical Site Plan(s)
- Lighting Plans
- Power Plans
- Lightning Protection Plans (may be combined with roof and ground floor/site power plans on projects with few lightning protection components)
- Telecommunications Plans
- Signal or Other Plans
- One-line Diagrams and Riser Diagrams
- Details
- Schedules, Summary Load Studies, Lighting Fixture Schedule

Fire alarm systems are part of the Fire Protection discipline, and shall be shown on the Fire Protection Plans.

Signal Systems may be combined with Power Systems on projects with a minimal number of signal devices.

1.9.3 ABBREVIATIONS AND SYMBOLS

Use only the abbreviations and symbols shown in the VA Standard Details (PG-18-4), and the NCS Application Guide.

1.9.4 PROPRIETARY ITEMS

Do not use trade names or other indications that identify a product of an individual manufacturer on any project, unless specifically approved and as follows:

- (a) Where necessary to identify existing equipment
- (b) Where an existing system is to be extended and competitive manufacturers cannot meet performance or dimensional requirements
- (c) Where required by a public utility or municipal system as a condition of its services, specifications shall state this condition

1.10 CALCULATIONS

1.10.1 GENERAL

It is the responsibility of the A/E to prepare and submit, or specify, calculations as required by the type of design work performed. Calculations shall justify lighting designs; size of each conductor, overcurrent protective device, equipment bus, generator, transformer, etc.; setting of each overcurrent protective device with adjustable characteristic; required PPE to meet arc flash energy levels; etc. It is the responsibility of the A/E to determine which calculations are performed by the A/E, and which calculations are to be specified by the A/E and performed by the Contractor. Not all calculation types will be required for all projects. VA reserves the right to request additional calculations to suit the project.

The A/E shall submit the following calculations to VA: fault current calculations, protective device coordination study when not required to be performed by the Contractor per Master Specification Section 26 05 71, arc flash calculations when not required to be performed by the Contractor per Master Specification Section 26 05 71, load calculations, generator-set sizing calculations, voltage drop calculations, harmonic distortion calculations, lightning protection system risk analysis, and lighting calculations.

1.10.2 FAULT CURRENT CALCULATIONS

Prepare and submit calculations for all new projects and renovations to existing electrical distribution systems. The available fault currents shall be included on the riser diagrams, and shall show the available fault current (expressed in amperes, RMS symmetrical) at each overcurrent protective device and transformer in the system. Supporting calculations (such as those resulting from a SKM PowerTools™ analysis) that justify the summary available fault currents on the riser diagrams may be submitted separately in 8.5 x 11 format.

1.10.3 PROTECTIVE DEVICE COORDINATION CALCULATIONS

Prepare or specify coordination curves to determine the required settings of protective devices to assure selective coordination. Refer to Master Specification Section 26 05 71, ELECTRICAL SYSTEM PROTECTIVE DEVICE STUDY, for more information.

1.10.4 ARC FLASH CALCULATIONS

Perform, or specify, an arc flash analysis in accordance with IEEE Std 1584a. For each bus analyzed, determine the following: Flash Hazard Protection Boundary, Incident Energy Level, Required Personal Protective Equipment Category, Type of Fire Rated Clothing, Limited Approach Boundary, Restricted Approach Boundary, and Prohibited Approach Boundary. Present, or specify to be submitted, the data determined by the analysis in a tabular format, and submit, or specify to be submitted, the preparation of arc flash warning labels for each piece of electrical equipment, showing the items listed above as well as the date of issue.

1.10.5 LOAD CALCULATIONS

Prepare and submit load calculations that justify the size of each branch circuit and feeder, overcurrent protective device, transformer, and equipment bus (panelboard, switchboard, switchgear, automatic transfer switch, etc.). Calculations shall be performed at all voltage levels. The method of calculation, including all applicable NEC diversity factors and non-coincident loads and their employment at various levels of the electrical system, as well as capacity reserved for future load, shall be clearly presented in the drawings. Calculations may be in panel schedule and switchboard schedule format. It shall be possible for the VA reviewer to follow the load flow from the lowest level to the highest level of the riser and one-line diagrams.

1.10.6 GENERATOR SIZING CALCULATIONS

Prepare and submit calculations that justify the size of each generator or paralleled fleet of generators, including but not limited all loads downstream of the generator set(s) and the sizing impacts of proposed load steps, significant motor loads, non-linear loads, and capacity reserved for future loads. If applicable under NEC Article 517, prudent demand factors and historical data used to justify generator set(s) sizing shall be clearly presented.

1.10.7 VOLTAGE DROP CALCULATIONS

Prepare and submit calculations demonstrating compliance with the following voltage drop limits: 2% for feeders, and 3% for branch circuits, taken at design load.

1.10.8 HARMONIC DISTORTION CALCULATIONS

For Energy Center projects only. Prepare and submit calculations estimating the voltage and current total harmonic distortion (THD) for buses rich in non-linear loads, typically Energy Center switchboards which feed large-horsepower pump motors controlled by adjustable speed drives. Use these calculations to justify active or passive components to mitigate harmonic distortion.

1.10.9 LIGHTNING PROTECTION CALCULATIONS

Prepare and submit calculations as described in Annex L of NFPA 780.

1.10.10 LIGHTING CALCULATIONS

Refer to Chapter 6.3, LIGHTING CALCULATIONS.

1.11 SEISMIC BRACING

1.11.1 REFERENCES

Refer to H-18-8, "VA Seismic Design Requirements". Coordinate with the Structural Engineer so that seismic bracing is provided as required.

1.11.2 DRAWINGS

Contract drawings shall show the detail methods of anchoring electrical equipment. Drawings shall include the size, number and type of anchors and fasteners to be used to secure the equipment against the seismic forces and to meet codes. Calculations for equipment anchoring shall be performed by a registered structural engineer.

1.11.3 EQUIPMENT BRACING

Refer to Section 13 05 41 for seismic bracing requirements. Typically, all lighting, power, telecommunications, and signal equipment and enclosures shall be seismically braced and/or anchored.

1.12 TRANSPORT SYSTEMS

Refer to PG-18-10, TRANSPORT SYSTEMS DESIGN MANUAL FOR HOSPITAL PROJECTS for requirements. Refer to PG-18-10, FIRE PROTECTION DESIGN MANUAL for fire alarm connection requirements.

1.13 FIRE ALARM SYSTEMS

Refer to PG-18-10, FIRE PROTECTION DESIGN MANUAL for requirements.

1.14 RENOVATION TO EXISTING SITES AND BUILDINGS

1.14.1 DRAWINGS

For renovation projects, separate demolition drawings are required for all areas involved in the project. Specific detailing of interfaces between renovated and existing-to-remain conditions shall be clearly indicated on the drawings. The Architect/Engineer must fully describe existing equipment affected by a renovation project, including but not limited to existing equipment manufacturer, model, voltage and amperage and A/C ratings, description, new devices installed, new wires and cables terminated, etc.

1.14.2 MODIFICATION VERSUS REPLACEMENT

Where equipment must be modified to be physically utilized in a project, the following items must be evaluated:

- (a) Can the government look to one manufacturer for final responsibility of the modified equipment?
- (b) Is there a legitimate cost saving by modifying the existing equipment rather than installing new? If yes, then modification should be considered.
- (c) What is the impact on operation and safety during and after construction?
- (d) Will the equipment retain a valid UL-listing after modification? If no, the equipment should be replaced.

1.14.3 AGE AND PHYSICAL CONDITION

- (a) The length of time in service and physical condition of wiring, devices and equipment should be reviewed prior to considering reuse.
- (b) The equipment should be capable of remaining in use for a minimum of 15 years of additional life or having 60 percent of remaining life, if not the equipment shall be replaced.
- (c) Where equipment has been in operation for a number of years, physical inspection of terminals, insulation, switching contacts, control wiring, etc., shall be examined and recommended for use by the A/E.

1.14.4 PARTS AVAILABILITY

- (a) After the A/E's site surveys, the availability of spare parts for existing equipment should be determined.
- (b) Where the project involves extending an existing system but the existing equipment spare parts are not available, the A/E should inform the VA Project Manager in writing. Specific directions will be given at that time.

1.14.5 CONDUIT AND BOXES

- (a) Conduit and boxes in existing walls to be demolished shall be removed.
- (b) Conduit and boxes in existing walls to remain shall be abandoned in place (if not reused) and the boxes shall be provided with blank covers.
- (c) Conduit in existing or new ceilings that is not intended for reuse shall be removed back to the power, telecommunications, or signal system source from where it originates.
- (d) Conduits that had been run in the existing concrete slab shall be saw-cut off as they enter the slab and then sealed to prevent moisture access.

1.14.6 CONDUCTORS

- (a) The A/E may wish to have the conductor meggered to assure insulation integrity. Conductors with known deteriorated or damaged insulation shall be replaced with new.
- (b) All abandoned conductors or conductors that are not deemed reusable shall be removed back to the nearest junction box. Where the entire circuit is to be removed, the conductors shall be removed back to the power, telecommunications, or signal system source from which they originate.
- (c) New conductors shall not be installed in existing conduit with existing conductors.

1.14.7 WIRING DEVICES

- (a) Remove devices that are not installed at reusable locations. Boxes shall be blanked.
- (b) Existing receptacles and switches in good operating condition, located at acceptable places, may be reused. Non-Hospital Grade receptacles shall be replaced in all patient areas with Hospital Grade receptacles.

1.14.8 LIGHTING FIXTURES

- (a) Lighting fixtures that cannot be reused shall be removed, including associated wiring to ceiling-mounted junction boxes.
- (b) Where fixtures are determined to be reusable in new or existing ceilings, per Master Construction Specification requirements they shall be cleaned, re-lamped, re-lensed and re-ballasted prior to being put back to service. Where existing exit signs are non-LED type, they shall be removed and replaced with an LED-type fixture.

1.14.9 PANELBOARDS

- (a) Consider panelboards for reuse if physical condition, voltage, current, and interrupting ratings and circuit capacity requirements are met.
- (b) Panelboards shall be installed in new or existing electrical rooms and closets. Corridor-mounted panel boards shall not be installed without specific approval from VA. Refer to other articles of this Manual for requirements.
- (c) In major secondary distribution renovation projects, existing panelboard back boxes may be used as pull boxes for branch circuit transfer. All branch circuit conductors shall be tagged to identify which circuit number they are being transferred to in the new panel. Provide clear requirements in the contract documents directing the Contractor to revise the circuit numbers on all junction and device boxes and wall plates for the entire run.

1.14.10 GOVERNMENT RETAINED EQUIPMENT

After consulting with the VA Medical Center, determine if the following items should be retained by government:

- Disconnects of 100 A (amperes) Motors and larger
- Fire Alarm Devices
- Nurse Call System Components
- Panelboards and Circuit Breakers
- Special Lighting Fixtures
- Special Receptacles
- Transformers
- Telecommunications System Components
- Signal Systems Components
- Power components installed to provide temporary construction electrical service, if not the property of the Contractor.

1.14.11 CONTINUITY OF SERVICE

- (a) Services passing through areas of remodeling shall be maintained throughout the construction period.
- (b) Circuits that are modified as part of a remodeling project, which serve areas adjacent to the construction area, shall be re-circuited as part of the project.
- (c) Provide new temporary and/or modify existing power, emergency power, lighting, fire alarm, telecommunications, and other services as required for construction-period Interim Life Safety measures.

1.14.12 COMPATIBILITY

Equipment installed shall be compatible to existing components and systems to which they interface.

This page intentionally left blank.

CHAPTER 2: RACEWAYS, WIRING AND EQUIPMENT

2.1	RACEWAYS.....	2-3
2.1.1	CONCEALED AND EXPOSED	2-3
2.1.2	UNDERGROUND DUCTS AND CONDUITS	2-3
2.1.3	SPARE CONDUITS.....	2-3
2.1.4	UNDERFLOOR DUCT SYSTEMS	2-3
2.1.5	RADIOLOGY ROOMS	2-4
2.1.6	POKE-THRUS/POWER POLES	2-4
2.1.7	ETHYLENE OXIDE STERILIZATION AREA.....	2-4
2.2	GROUNDING	2-5
2.2.1	GROUNDING ELECTRODES.....	2-5
2.2.2	EQUIPMENT GROUNDING CONDUCTORS	2-5
2.2.3	METAL CURTAIN WALL GROUNDING	2-5
2.3	LIGHTNING PROTECTION SYSTEM.....	2-5
2.4	MOTOR DISCONNECT SWITCHES	2-5

This page intentionally left blank.

2.1 RACEWAYS

Install all wiring in raceways. Open wiring is prohibited. Raceways shall be those as specified in PG-18-1, Master Specifications.

2.1.1 CONCEALED AND EXPOSED

- (a) Exposed conduit is acceptable where finished ceilings are not provided. Wherever it is physically impractical to conceal conduits due to economic considerations or to accommodate existing field conditions, the A/E shall consult with VA to determine acceptable alternatives.
- (b) Electrical conduits may be installed in concrete walls and floors.
- (c) Surface metal raceways shall not be installed on the floor. Services to equipment in open non-patient-care areas shall be served from under the slab or through tele/power poles wired from the ceiling.
- (d) Primary-voltage feeders shall not be exposed on the exterior of buildings.

2.1.2 UNDERGROUND DUCTS AND CONDUITS

- (a) Generally, encase underground ducts and conduits in concrete. Direct burial conduit may be used for outdoor lighting and power branch circuits.
- (b) The A/E shall make project-specific recommendations for reducing the concrete encasement requirement, taking into account the importance and physical security needs of the conduit(s) in consideration. Conduits containing Essential Electrical System wiring and telecommunications cabling shall not be exempt from the concrete encasement requirement.

2.1.3 SPARE CONDUITS

Where electrical capacity is reserved for future use, such as bussed space in panelboards, motor control centers, switchboards, and switchgear of all voltage levels, and where under-slab or underground conduit is used, the A/E shall provide spare under-slab or underground conduits to an accessible point. The number and size of conduits shall be appropriate to the equipment and amount of bussed space served.

2.1.4 UNDERFLOOR DUCT SYSTEMS

- (a) For new construction of large office areas, provide underfloor power, telecommunications, and signal systems ducts for the following areas:
 - Personnel Division
 - Registrar Division
 - Fiscal Division

- Supply Division
 - Other - Any large open office spaces where future flexibility is desirable
- (b) Provide duplex receptacle and telecommunications outlet fittings on the underfloor duct to suit the furniture layout.
- (c) Space the underfloor ducts 5 ft. [1.5m] on centers. In structural steel frame buildings, use trench header and utilize the cellular steel as the raceway. Coordinate with the structural engineer to insure that the proper cells are enclosed for raceway use.

2.1.5 RADIOLOGY ROOMS

- (a) Radiology rooms typically require a manufacturer-specific conduit and wiring trough system. If VA Medical Center has selected a manufacturer, the A/E may base their design on the manufacturer's shop drawings. If the equipment list is non-manufacturer-specific, the A/E should base the design on a typical radiology system for bidding purposes.
- (b) The A/E shall provide the following details on the electrical plans for the Radiology Room(s):
- Power and Signal Plan: A/E shall show complete design for general use receptacles, communication and signal outlets. A/E shall show main circuit and related equipment servicing the radiology equipment. A/E shall confirm radiology equipment power requirement with radiology shop drawings.
 - Lighting Plan: A/E shall show complete lighting design. A/E shall coordinate lighting locations with radiology shop drawings and drawings from other trades to avoid conflict in field installation.
 - Radiology Raceway Layout Plans: A/E shall show all surface and or recess mounted raceway systems. A/E shall show wiring tags for all raceway runs. A/E shall coordinate existing field conditions, locations, sizes and quantities of raceways and cables shown on radiology shop drawings with drawings from other trades to avoid conflict in field installation.
 - Radiology Wiring Schedule: A/E shall show a schedule for all wiring tags indicating wiring destinations and locations/sizes/types/quantities of all raceways and wirings.
 - A/E shall verify that the proposed radiology equipment installation as shown on radiology shop drawings meets all applicable codes, regulations and existing building conditions.

2.1.6 POKE-THRU/POWER POLES

In renovation projects for large administrative areas, use fire-rated poke-thru devices and/or power poles, as determined by VA.

2.1.7 ETHYLENE OXIDE STERILIZATION AREA

Determine the extent of the NEC classified area (if any) in the vicinity of ethylene oxide sterilizers and provide an appropriate raceway system and devices.

2.2 GROUNDING

The grounding system shall be shown complete on the One-line Diagram with all components and descriptions from the medium- or low-voltage service to the low-voltage panels, as applicable for each project. The grounding system shall be shown complete on the One-line Diagram for the Normal, Standby, and/or Essential Electrical Systems, including but not limited to generators, automatic transfer switches, electrical equipment, etc.

2.2.1 GROUNDING ELECTRODES

Galvanized steel or copper-clad steel electrodes may be used. All electrodes are to be of the same material for the entire project.

2.2.2 EQUIPMENT GROUNDING CONDUCTORS

All raceways shall contain an equipment grounding conductor. Coordinate with VA Master Specifications and show on the drawings.

2.2.3 METAL CURTAIN WALL GROUNDING

- (a) To help ensure that personnel are not exposed to electrical shock, all exterior metal sheathing of buildings shall be grounded.
- (b) For buildings having perimeter not exceeding 250 ft. [76m], the sheathing shall be grounded at diagonally opposite corners of the building.
- (c) Buildings exceeding 250 ft. [76m], the perimeters shall be grounded such that the spacing between grounding points does not exceed 100 ft. [30m].
- (d) A ground point shall consist of a driven ground rod and brazed connection to the building sheath. A No. 6 AWG bare copper conductor shall be used to connect the sheath to the ground rod.
- (e) Where a lightning protection system is provided for the building, the sheath shall also be bonded at each down conductor location.

2.3 LIGHTNING PROTECTION SYSTEM

- (a) Lightning protection is mandatory for all Mission Critical buildings. For non-Mission Critical buildings, perform risk analysis per NFPA 780, Annex L and provide a lightning protection system where $N_d > N_c$. Submit calculations to VA.
- (b) Lightning protection systems shall comply with NFPA 780 – Standard for the Installation of Lightning Protection Systems and NFPA 70 – National Electrical Code.

2.4 MOTOR DISCONNECT SWITCHES

Provide all motors with a local disconnect switch (unfused unless required otherwise) located at the motor or a maximum of 5 ft. [1.5m] away within sight. Clearly indicate this requirement on the Contract Drawings.

This page intentionally left blank.

CHAPTER 3: RECEPTACLE AND POWER REQUIREMENTS

3.1	GENERAL	3-3
3.2	ESSENTIAL ELECTRICAL SYSTEM CIRCUITS.....	3-3
3.3	RECEPTACLE CIRCUITS.....	3-3
3.4	SPECIFIC APPLICATIONS.....	3-3
3.4.1	GROUND FAULT CIRCUIT INTERRUPTER RECEPTACLES.....	3-3
3.4.2	HUMAN SURGERY ROOMS.....	3-3
3.4.3	ICU-CCU FOOT-WALL RECEPTACLES.....	3-3
3.4.4	EXTERIOR ELECTRICAL RECEPTACLES.....	3-4
3.4.5	WAITING, LOUNGE AND LOBBY AREAS	3-4
3.4.6	ANIMAL SURGERY ROOMS.....	3-4
3.4.7	SELF-ILLUMINATED EMERGENCY RECEPTACLES.....	3-4
3.4.8	SPECIAL PROCEDURES ROOM – ISOLATED POWER	3-5
3.4.9	CORRIDORS	3-5
3.4.10	KITCHENS	3-5
3.4.11	OFFICES AND ADMINISTRATIVE AREAS	3-5
3.4.12	LABORATORIES AND RESEARCH FACILITIES.....	3-5
3.4.13	PHYSICAL MEDICINE AND REHABILITATION SERVICE	3-5
3.4.14	PSYCHIATRIC PATIENT ROOMS.....	3-6
3.4.15	STAIRWELLS.....	3-6
3.4.16	INTERSTITIAL SPACES.....	3-6
3.4.17	TV/CCTV POWER RECEPTACLES	3-6
3.4.18	ELECTRICAL CLOSETS	3-6
3.4.19	TELECOMMUNICATIONS ROOMS	3-6
3.4.20	MOTORIZED TREADMILLS	3-6

This page intentionally left blank.

3.1 GENERAL

- (a) "Receptacle" refers to power receptacles, except where signal types are specifically noted. Provide safety receptacles, ground fault current interrupter receptacles, or other special purpose receptacles as required for the project. All receptacles shall be duplex NEMA 5-20R unless otherwise noted or not commercially available in a particular size. In patient care buildings, all receptacles shall be UL-listed as Hospital Grade, where available, in the size, type and configuration required.
- (b) The A/E should refer to the appropriate Design Guide, where most receptacle requirements are shown.

3.2 ESSENTIAL ELECTRICAL SYSTEM CIRCUITS

Refer to [Chapter 4](#), "Essential and Standby Electrical Power Systems", for devices to be backed by an alternate source of power.

3.3 RECEPTACLE CIRCUITS

No more than 6 receptacles shall be installed on a single branch circuit for general use.

3.4 SPECIFIC APPLICATIONS

3.4.1 GROUND FAULT CIRCUIT INTERRUPTER RECEPTACLES

Provide GFCI receptacles at all locations required by NFPA 70 and 99. GFCI receptacles shall not serve other receptacles from their load-side terminals.

3.4.2 HUMAN SURGERY ROOMS

- (a) Refer to Surgical Service Design Guide.
- (b) Each receptacle shall be on its own Critical Power dedicated circuit in a dedicated homerun conduit, except for those mounted in the service columns which may be wired two to a circuit. Multiwire Critical Branch circuits are not allowed in human surgery rooms.
- (c) Wall mounted receptacles shall be 18 in. [450mm] above the floor.
- (d) The need for special receptacles for surgical lasers or portable equipment shall be determined on a project-by-project basis.

3.4.3 ICU-CCU FOOT-WALL RECEPTACLES

Provide two receptacles on the foot-wall or side wall near the foot of beds in Intensive Care cubicles or Isolation Rooms. Feed these receptacles from different circuits in the respective Prefabricated Bedside Patient Unit (PBPU). Refer to [Chapter 9](#) for PBPU requirements.

3.4.4 EXTERIOR ELECTRICAL RECEPTACLES

Provide exterior weatherproof GFCI receptacles mounted in NEMA 3R weatherproof enclosures, at a maximum of 75 ft. [25m] spacing, at the following locations. Branch circuits for such receptacles may feed more than one receptacle, but should not also feed interior receptacles.

- Exterior walls of penthouses for maintenance of roof areas
- Major entrances to buildings
- Courtyards and enclosed (or partially enclosed) garden areas
- Loading docks and maintenance yards
- Major mechanical equipment enclosures
- Cooling towers
- Major service equipment enclosures
- At locations above where sanitary sewer piping exits the building footprint, for connection of sewer cleaning equipment.

3.4.5 WAITING, LOUNGE AND LOBBY AREAS

Provide tamper-resistant receptacles in every 8 ft. [2.4m] in Waiting, Lounge and Lobby areas.

3.4.6 ANIMAL SURGERY ROOMS (RESEARCH)

- (a) Design operating rooms for non-flammable anesthetics only.
- (b) Provide non-explosion proof, locking receptacles at ceiling locations and Hospital Grade receptacles at wall locations.
- (c) Provide eight single, Hospital Grade power receptacles for general use at each table: four flush mounted in the ceiling (two at each end of the table) and four distributed on the permanent wall(s) associated with the table.
- (d) Provide one power receptacle on each wall mounted at 4 ft. [1.2m] above the floor.
- (e) Provide portable X-ray outlet at 4 ft. [1.2m] above the floor.
- (f) Provide X-ray film viewers at 4 ft. [1.2m] above the floor to the bottom of the unit.

3.4.7 SELF-ILLUMINATED EMERGENCY RECEPTACLES

In rooms without general illumination on emergency power, emergency receptacles shall be of the self-illuminated type. Night lights, pilot lights, and instrument lights are not considered general illumination.

3.4.8 SPECIAL PROCEDURES ROOM - ISOLATED POWER

In renovation projects that affect existing isolated power systems, the A/E shall coordinate with the VA Project Manager and the Medical Center to determine whether to modify an existing isolated power system, or remove it and install new non-isolated power components.

3.4.9 CORRIDORS

Provide receptacles for cleaning machines that are no more than 75 ft. [23m] apart, except that in corridors of Nursing Units, the receptacles shall be a maximum of 40 ft. [12m] apart. These receptacles shall be on a dedicated circuit serving only corridor receptacles.

3.4.10 KITCHENS

- (a) Coordinate requirements with kitchen equipment list. Provide appropriate receptacles for each piece of kitchen equipment that is cord connected. Other equipment shall be permanently wired using liquid tight flexible conduit.
- (b) Provide receptacles for pieces of equipment located on an island with an island-mounted, waterproof, floor pedestal type receptacles.
- (c) Provide means to disconnect electrical power to all equipment beneath Type I hoods if the fire suppression is activated.

3.4.11 OFFICES AND ADMINISTRATIVE AREAS

- (a) Small Rooms: Provide receptacles with spacing not to exceed 10 linear ft. [3m] as measured around the floor line, excluding doorways. For all linear wall space 5 ft. [1.5m] and longer, provide at least one receptacle for general and computer uses.
- (b) Open Spaces and Large Rooms: Install receptacles for large administrative rooms in underfloor raceways or in Tele/Power poles. Refer to [Article 2.1.4 – Underfloor Duct Systems](#).

3.4.12 LABORATORIES AND RESEARCH FACILITIES

Refer to Research Laboratory Design Guide.

3.4.13 PHYSICAL MEDICINE AND REHABILITATION SERVICE

- (a) Occupational Therapy Preparation and Treatment Rooms, Occupational Therapy Clinics and Manual Arts Therapy Clinics: Provide heavy-duty multiple surface metal raceway 208 V (volt) and 120V receptacles at 48 in. [1.2m] intervals on walls with their centerlines located 40 in. [1.0m] above the finished floor.
- (b) Educational Therapy Classrooms: Provide light-duty 120V surface metal raceway receptacles at 36 in. [900mm] intervals on all walls with their centerlines located 40 in. [1.0m] above the finished floor.

- (c) Other Receptacles: When appropriate, provide safety receptacles for other services in the RMS Area. Flush-mount all floor receptacles in treatment areas with appropriate removable covers.

3.4.14 PSYCHIATRIC PATIENT ROOMS

Provide GFCI tamper-resistant receptacles with beveled, metal-edged cover plates in psychiatric patient rooms. Psychiatric patient room receptacles shall be on a dedicated circuit so that they may be shut off independently, without affecting other rooms.

3.4.15 STAIRWELLS

Provide a receptacle at every other floor landing for vacuum cleaning.

3.4.16 INTERSTITIAL SPACES

Provide receptacles at every other column. Where catwalks are installed because of the inability to install a walk-on platform, provide receptacles along the catwalks at spacing not to exceed 40 ft. [12m]. In addition, provide receptacles at each entrance to the interstitial space.

3.4.17 TV/CCTV POWER RECEPTACLES

Provide a receptacle in conjunction with each CCTV camera, CCTV monitor and TV receiver. Such receptacles are not necessary where the equipment is low-voltage-powered by headend equipment.

3.4.18 ELECTRICAL CLOSETS

Provide a receptacle with its centerline located 40 in. [1.0m] above the finished floor adjacent to the room door.

3.4.19 TELECOMMUNICATIONS ROOMS

Refer to [Article 8.9](#).

3.4.20 MOTORIZED TREADMILLS

If not provided integral to the treadmill, provide an in-line circuit interrupter at the treadmill unit which requires manual resetting to restore power in the event of a power interruption.

CHAPTER 4: ESSENTIAL AND STANDBY ELECTRICAL POWER SYSTEMS

4.1	GENERAL	4.3
4.2	MIXED ESSENTIAL AND STANDBY ELECTRICAL POWER SYSTEMS...	4-3
4.3	COMMISSIONING	4-3
4.4	EQUIPMENT AND RATINGS.....	4-3
4.4.1	GENERATORS	4-3
4.4.2	AUTOMATIC TRANSFER SWITCHES	4-3
4.4.3	CONTROL NETWORK.....	4-3
4.4.4	DIESEL FUEL STORAGE	4-4
4.4.5	LOCATION	4-4
4.5	EXISTING FACILITIES	4-4
4.6	ESSENTIAL ELECTRICAL SYSTEMS FOR HOSPITALS.....	4-4
4.6.1	ENFORCING CODES	4-4
4.6.1.1	Life Safety Branch	4-4
4.6.1.2	Critical Branch	4-5
4.6.2	EQUIPMENT BRANCH	4-6
4.6.2.1	Equipment Branch Non-Delayed Automatic Connection.....	4-6
4.6.2.2	Equipment Branch Delayed-Automatic Connection	4-6
4.6.3	ALTERNATE SOURCE OF POWER	4-8
4.7	ESSENTIAL ELECTRICAL SYSTEM FOR NURSING HOMES AND LIMITED CARE FACILITIES	4-8
4.7.1	LIFE SAFETY BRANCH.....	4-8
4.7.2	CRITICAL BRANCH	4-9
4.7.3	ALTERNATE SOURCE OF POWER	4-9
4.8	ESSENTIAL ELECTRICAL SYSTEM FOR OTHER HEALTHCARE FACILITIES	4-9
4.8.1	TYPE 3 LOADS	4-9
4.8.2	ALTERNATE SOURCE OF POWER	4-9
4.9	ESSENTIAL ELECTRICAL SYSTEM FOR OTHER FACILITIES	4-9
4.9.1	BOILER PLANT AND ENERGY BUILDINGS.....	4-9
4.9.2	FIRE STATION.....	4-9
4.10	STANDBY ELECTRICAL SYSTEM FOR MISSION CRITICAL FACILITIES	4-10
4.10.1	REQUIREMENTS	4-10
4.10.2	STANDBY SOURCE OF POWER.....	4-10

This page intentionally left blank.

4.1 GENERAL

This article covers the Essential Electrical Systems and Standby Electrical Systems.

4.2 MIXED ESSENTIAL AND STANDBY ELECTRICAL POWER SYSTEMS

- (a) For facilities where full standby power is required, it is permissible for the Standby Electrical System generators to provide power to the Essential Electrical System, if the Standby Electrical System, as a whole, meets the requirement of the NFPA 99, NFPA 110 and other applicable Codes.
- (b) Refer to Appendix B – Drawings for more information on possible system topologies.

4.3 COMMISSIONING

- (a) In addition to installation acceptance testing specified in NFPA 110, the Essential Electrical System shall be commissioned to ensure proper operation of individual components and the system as a whole. A commissioning plan shall be developed, specified, documented, and executed. The commissioning shall include, but is not limited to, all sources of power, paralleling switchgear, transfer switches, fueling systems and tank leak detection, interconnections to other systems, annunciators, load shedding, exercise functions, peak shaving, and communications pathways between equipment.
- (b) Control and operation drawing(s) shall be prepared by the A/E, or required by the A/E to be prepared by the Contractor, as part of system commissioning and operations and maintenance documents. The drawings shall show all elements of the system and their interrelationships, including both power and control interconnections and sequences of operation. Physical locations of equipment shall be included.

4.4 EQUIPMENT AND RATINGS

4.4.1 GENERATORS

Generators used for the Standby Electrical System shall be rated as limited-running-time prime power. If separate from the Standby Electrical System generators, generators dedicated to the Essential Electrical System shall be rated as standby.

4.4.2 AUTOMATIC TRANSFER SWITCHES (ATS)

ATS shall be 4-pole, and shall include the maintenance-bypass option. ATS shall be limited to 800 amperes maximum size and located to provide the highest practicable reliability in service to the load. This generally means minimizing the switch-to-load distance.

4.4.3 CONTROL NETWORK

ATS, generator remote alarm systems, load shedding controls, and other interconnecting control components of the Standby Electrical System and/or the Essential Electrical System shall be networked over a fiber-optic communications network, which shall not be used to

transport information of other systems, and shall be installed in dedicated raceways. The ATS shall be able to be monitored, tested, and operated from a single location; typically the paralleling switchgear.

4.4.4 DIESEL FUEL STORAGE

Diesel storage tank(s) shall be provided with leak detection, and means to prevent degradation of stored fuel due to oxidation, microorganism growth, and corrosion.

4.4.5 LOCATION

- (a) Do not locate the first level of distribution of the Standby Electrical System or Essential Electrical System, such as the generators and paralleling switchgear, in the same room with other power systems.
- (b) In the generator paralleling switchgear or distribution switchboard, Life Safety Branch overcurrent protective devices shall occupy a dedicated section or sections.

4.5 EXISTING FACILITIES

- (a) Variations in wiring arrangements in existing facilities are acceptable if an equivalent degree of performance and reliability is not compromised. Such variations may particularly occur with certain wiring in separate or common raceways, with certain functions connected to one or another system or branch, or with certain provisions for automatically or manually delayed restoration of power from the alternate (emergency) source of power.
- (b) The A/E will submit a narrative describing the existing conditions, and how the new design best meets the intent of applicable codes, and provides an equivalent degree of performance and reliability.
- (c) When adding new ATS to an existing Essential Electrical System, the A/E shall match the existing pole switching configuration, i.e., 3-pole or 4-pole transfer switches.

4.6 ESSENTIAL ELECTRICAL SYSTEMS FOR HOSPITALS

The Essential Electrical System for hospitals shall comply with the Type 1 system as defined in NFPA 99.

4.6.1 ENFORCING CODES

All requirements for the Emergency System shall comply with NFPA 70, 99 and 110.

4.6.1.1 LIFE SAFETY BRANCH

Shall supply power to loads per NFPA 70 and 99, including.

- Alarm and alerting systems, such as Fire Alarm and Medical Gas Systems
- Automatic doors: Used for building egress
- Elevator cab lighting, control, communication, and signal systems

- Exit signs
- Generator set location: Task illumination, battery charger for emergency battery-powered lighting units and selected receptacles
- Illumination of means of egress
- Telecommunications Systems where used for issuing instructions during emergency conditions, including public address and Code One (Blue) systems and Disaster Control or Emergency Communication Centers

4.6.1.2 CRITICAL BRANCH

Shall supply power to loads per NFPA 70 and 99, and as described below.

- Acute Nursing: Task illumination and selected receptacles
- Stepdown Units: Task illumination and selected receptacles
- Anesthetizing Locations: Task illumination, selected receptacles and fixed equipment; task illumination includes battery back-up
- Angiographic Laboratories: Task illumination, selected receptacles and selected power circuits
- Blood, Bone, Eye and Tissue Banks: Task illumination, selected receptacles and refrigerators
- Cardiac Catheterization Laboratories and Rooms: Task illumination and X-ray unit
- Coronary Care Unit: Task illumination and PBPUs
- Emergency Room Treatment Areas and Life Support Rooms: Task illumination and PBPUs
- General Patient Bedrooms: Night lights, an alcove or a lavatory mirror light, one receptacle per bedwall, preferably in the PBPU, if available and a bathroom light
- Hemodialysis Rooms: Task illumination and one receptacle for each dialysis unit PBPU
- Human Physiology Labs: Task illumination, selected receptacles and selected circuits
- Intensive Care Units: Task illumination and PBPUs
- Medication Rooms and Medication Preparation Areas: Task illumination, selected receptacles and refrigerators
- Minor Operating Rooms: Task illumination and selected receptacles
- Nurse Call systems
- Nurses' Stations: Task illumination and selected receptacles
- Pharmacy Dispensing Area (including Satellite Pharmacies): Power files, laminar flow hoods, refrigerators, copier for transmittal of physicians' orders, task illumination and selected receptacles
- Psychiatric Bedrooms: Task illumination (ceiling only)
- Surgical Operating Rooms: Task illumination (50 percent of the general fluorescent fixtures above the surgery table including battery backup within two of these fixtures), each X-ray unit and one film processor per suite
- Surgical Recovery Rooms: Lighting fixture over each bed, one receptacle for each bed (or PBPU), night lights for each bed (or PBPU) and emergency alarm circuits
- Main Computer Room, Telephone Equipment Room, Telephone Console Room, Head End Room, and Telecommunications Rooms: All UPS equipment, lighting, and receptacles
- Ward Treatment Rooms: Task illumination and selected receptacles

- Dental Suites: Each ceiling track operatory surgical light, each dental operating unit, one duplex receptacle in each treatment area and a storage refrigerator
- Electrical Rooms: 50 per cent of lighting and 50 per cent of receptacles; also provide additional battery-powered lighting main electrical room
- Engineering Control Center and Mechanical Equipment Rooms: UPS equipment, task illumination and selected receptacles for operating and controlling internal auxiliary power, data gathering panels, control air compressors, and dryers and any electric control for heating, ventilating and air-conditioning (HVAC) systems
- Laboratory Service: Task illumination, selected receptacles in areas used to continue essential functions or critical experiments in the event of power failure, fume hoods, exhaust fans and refrigerators
- Pharmacy Delivery Systems and Delivery Areas: Task illumination, selected receptacles, dumbwaiter for delivery of STAT requests and pneumatic tube system for STAT requests if no other delivery system is readily available
- Respiratory Care Beds: PBPU; when PBPU is not provided, task illumination and one receptacle for each bed
- Security Station: Monitoring security alarm systems, task illumination, one receptacle, intrusion and duress alarms at agent cashier, pharmacy, drug storage room in warehouse, canteen office, canteen retail store room and canteen storage
- Special Procedure Rooms (Radiology): Task illumination and X-ray unit
- HVAC for Surgical Suites, Intensive Care, Coronary Care and Emergency Treatment Spaces, and other areas as deemed necessary by VA
- Medical dispensing equipment

4.6.2 EQUIPMENT BRANCH

Shall supply power to loads per NFPA 70, 99, and 110.

4.6.2.1 Equipment Branch Non-Delayed Automatic Connection

Arrange the following generator accessories for non-delayed automatic connection to the alternate power source:

- Electrically operated louvers
- Other generator accessories essential for generator operation
- Transfer fuel pump

4.6.2.2 Equipment Branch Delayed-Automatic Connection

Arrange the following equipment for delayed-automatic connection to the alternate power source, including necessary controls:

- Vacuum pumps and oral evacuation pumps serving medical and surgical functions, including controls
- Sump pumps and other equipment required to operate for the safety of major apparatus, including associated control systems and alarms
- Medical and dental air compressors, serving medical and surgical functions, including controls (such systems may be connected to the Critical Branch; the A/E shall coordinate with the Chief Engineer at the facility)

CHAPTER 4: ESSENTIAL AND STANDBY ELECTRICAL POWER SYSTEMS

- Smoke control and stair pressurization
- Kitchen hood supply and/or exhaust systems, if required to operate during a fire in or under the kitchen hood
- Uninterruptible Power Supply (UPS) equipment serving other than telecommunications equipment
- Medical and laboratory refrigerators and freezers as required
- Oxygen storage control panel
- Equipment and control systems for each elevator bank: Design control systems to operate at least one elevator at a time and designate one elevator to serve the Surgical Suite during emergencies
- Fire pump, jockey pump, and make-up pump for water-based fire protection systems; lighting and selected receptacles in fire pump room
- Hyperbaric facilities
- Hypobaric facilities
- Automatic operated doors
- Autoclaving equipment (shall be permitted to be arranged for either delayed-automatic or manual connection to the alternate source)
- Administrative Areas: Task illumination and selected receptacles in the hospital Director's, Engineering, and Security and Communications Suites
- Closed-loop water chilling equipment for linear accelerator
- Domestic Water Pumps: Equipment, control system, light fixture and receptacle near the pump
- Electric tape for heat tracing of piping requiring freeze protection
- Heating, ventilating and air-conditioning (HVAC) systems:
 - Heating Equipment: Operating Suites, Recovery, Intensive Care, Coronary Care, Infection and/or Isolation Rooms, Emergency Treatment Spaces and General Patient Rooms; under certain conditions, NFPA 99 may not require heating of General Patient Rooms and Infection Isolation Rooms
 - Air-conditioning equipment, lubricating oil pumps for centrifugal compressors, control air compressors, air dryer and absorption machine refrigerant pump to draw down lithium chloride before crystallization (omit for machines accomplishing this manually)
 - Chillers, chilled water circulating pumps, fans, and controls for surgical suites, recovery rooms, intensive care, and coronary care units
 - Chillers, chilled water circulating pumps, fans and controls for animal research facilities
 - HVAC equipment for Bone Marrow Transplant (BMT) areas
 - HVAC equipment for Magnetic Resonance Imaging (MRI) Suites and Computerized Topographic (CT) Scanners
 - HVAC equipment serving emergency areas in outpatient clinics in seismic and high-risk hurricane areas
 - HVAC equipment for Main Computer Room and Telephone Equipment Room, Telephone Console Room, and Head End Room
 - Exhaust fans serving Autopsy Rooms, reagent-grade Water Treatment Rooms, Orthotic Laboratory special exhaust systems, battery charging areas, flammable storage rooms and illustration rooms (Medical Media)

- Supply, return and exhaust ventilating systems for Infection Isolation Rooms, Protective Environment Rooms and exhaust fans for laboratory fume hoods and nuclear medicine areas where radioactive material is used. These systems are permitted on delayed automatic system only and shall not be served via manual system. Some systems may be placed on Critical Branch. Coordinate with VA
- Ventilation, cooling and control equipment for electrical rooms
- Ventilation, cooling and control equipment for elevator machine rooms
- Hot Water Circulatory and Steam Condensate Return Pumps: Equipment, controls, and light fixture and receptacle near the pumps
- Hot Water Generator: Equipment, controls, and light fixture and receptacle near the generator
- Kitchen: Illumination and minimum equipment to feed patients during extended outage; freezers and refrigerators
- Laboratory Air Compressors and Vacuum Pumps: Equipment, controls, and light fixture and receptacle near the compressors and pumps
- Animal Ward lighting
- Mortuary Refrigerator or Cold Room: refrigeration equipment and task illumination
- Radiology Suite: Task illumination, one automatic X-ray film processor, and one X-ray unit
- Refrigerated Medical Storage: refrigeration equipment
- Sewage Pumps: Equipment, controls, and light fixture and receptacle near the pumps
- Supply, Processing, and Distribution (SPD):
 - Task illumination and selected receptacles in the following areas: core, sterile storage, non-sterile storage, preparation, and decontamination
 - One ultrasonic cleaner, one ethylene oxide gas sterilizer, one steam sterilizer, one washer sterilizer, one gas generator
 - Equipment in warehouse areas needed to preserve subsistence drugs and X-ray film materials that may be subjected to damage from infestation, humidity or temperature
- Water and Sewage Treatment Plant: Lighting, receptacles and equipment needed during emergency

4.6.3 ALTERNATE SOURCE OF POWER

- (a) The alternate source of power shall be one or more diesel-engine-driven-generator sets. Provide physical space for one additional generator; paralleling switchgear shall be appropriately provisioned. Refer also to the Physical Security Design Manual.
- (b) Coordinate location(s) for generator remote alarm annunciator(s) with VA. The preferred locations are in the Energy Center control room, and the Security office or Telephone Operator office (whichever is continuously staffed).

4.7 ESSENTIAL ELECTRICAL SYSTEM FOR NURSING HOMES AND LIMITED CARE FACILITIES

The Essential Electrical System for nursing homes and limited care facilities shall comply with the Type 2 system as defined in NFPA 99.

4.7.1 LIFE SAFETY BRANCH

Shall supply power to loads per NFPA 70 and 99

4.7.2 CRITICAL BRANCH

- (a) Shall supply power to loads per NFPA 70 and 99.
- (b) In addition, connect the following items to the Critical Branch, arranged for delayed-automatic connection to the alternate power system:
- Nurse Call System
 - Patient Bedrooms: Bathroom light, an alcove or lavatory mirror light, night light, and one receptacle per bed wall
 - Electrical Rooms and Closets: 50 percent of lighting and one receptacle
 - Main Computer Room, Telephone Equipment Room and Telecommunications Rooms: UPS equipment, 50 percent of lighting, all receptacles and telecommunications equipment
 - Mechanical Rooms: Task illumination and one receptacle

4.7.3 ALTERNATE SOURCE OF POWER

The alternate source of power shall consist of a diesel engine-driven generator set.

4.8 ESSENTIAL ELECTRICAL SYSTEM FOR OTHER HEALTHCARE FACILITIES

The Essential Electrical System for other health care facilities shall comply with the Type 3 system as defined in NFPA 99. If electrical life support equipment is required or critical care areas are present in the facility, the Essential Electrical System shall comply with the Type 1 system as defined in NFPA 99. If a Type 1 system is required, connect the functions/items listed above in [Article 4.6](#) to the Essential Electrical System.

4.8.1 TYPE 3 LOADS

The Type 3 Essential Electrical System shall supply power for the task illumination and limited power service that is related to the safety of life, and that is necessary for the safe cessation of procedures in progress.

4.8.2 ALTERNATE SOURCE OF POWER

Per NFPA 70 and 99.

4.9 ESSENTIAL ELECTRICAL SYSTEM FOR OTHER FACILITIES

4.9.1 BOILER PLANT AND ENERGY CENTER

Provide emergency power for task illumination and equipment necessary for emergency operations during an extended power outage. These buildings generally have their own diesel engine-driven generator set.

4.9.2 FIRE STATION

Provide emergency power for lighting and communication circuits necessary to sustain operation during power outages. If emergency generator power from an adjacent Boiler Plant or Energy Center is not available, provide auxiliary battery-powered lighting and communication devices.

4.10 STANDBY ELECTRICAL SYSTEM FOR MISSION CRITICAL FACILITIES

4.10.1 REQUIREMENTS

- (a) A Standby Electrical System may be required to provide full power backup for Mission Critical facilities. The Standby Electrical System shall be sized for full load operation of the entire electrical system, and must be capable of sustaining operation of all electrical loads for a minimum four-day period during which the electric utility source is not available. Additional sustainability time may be required for hurricane-prone areas, arctic areas, high-seismic areas, areas vulnerable to other natural disasters, Continuity of Operation Plan (COOP) facilities, or for other locations as specified by VA.
- (b) The Standby Electrical System may be sized, if required by VA, to provide power for other new or existing buildings or loads in addition to the Mission Critical facility.

4.10.2 STANDBY SOURCE OF POWER

- (a) The source of power shall be one or more indoor diesel generator sets that generate at the utility service entrance voltage, typically 5kV or 15kV nominal. The point of connection shall typically be the utility service entrance point. The generators shall be rated limited-running-time prime power, with a suggested limit of 750 hours of yearly operation at prime power rating.
- (b) Provide physical space for one additional generator; paralleling switchgear shall be appropriately provisioned.
- (c) Investigate peak shaving, cogeneration, or load interruption incentives with the serving electrical utility and submit an analysis narrative with recommendations to VA. Unless an advantageous interconnection agreement is obtained, the standby power system will not parallel with the utility.
- (d) The location of the standby power system, including switchgear and diesel fuel storage, shall comply with the Electrical Design Manual, the Physical Security Design Manual, and applicable Codes.

CHAPTER 5: ELECTRICAL POWER DISTRIBUTION

5.1	UTILITY SERVICE	5-3
5.2	PRIMARY DISTRIBUTION.....	5-3
5.2.1	GENERAL	5-3
5.2.2	PRIMARY SWITCHGEAR.....	5-3
5.2.3	PRIMARY CABLING	5-4
5.2.4	BUILDING PRIMARY-VOLTAGE DISCONNECTING MEANS	5-4
5.3	SECONDARY DISTRIBUTION	5-4
5.3.1	GENERAL	5-4
5.3.2	MEDIUM-TO-LOW VOLTAGE TRANSFORMERS	5-4
5.3.3	LOW VOLTAGE TRANSFORMERS	5-4
5.3.4	SWITCHBOARDS, SWITCHGEAR, AND MOTOR CONTROL CENTERS	5-4
5.3.5	PANELBOARDS	5-5
5.3.6	TRANSIENT VOLTAGE SURGE SUPPRESSION	5-5
5.3.7	LOADS FED FROM UNINTERRUPTIBLE POWER SUPPLY (UPS)	5-5
5.4	POWER MONITORING AND METERING	5-5
5.4.1	GENERAL	5-5
5.4.2	ENERGY CENTERS	5-5
5.4.3	EXISTING FACILITIES	5-6
5.5	ELECTRICAL ROOMS AND CLOSETS	5-6
5.5.1	GENERAL	5-6
5.5.2	SPACE FOR FUTURE EQUIPMENT.....	5-7
5.6	ELECTRICAL FACILITIES FOR OPERATING ROOMS.....	5-7
5.7	ELECTRICAL FACILITIES FOR ELEVATORS.....	5-7

This page intentionally left blank.

5.1 UTILITY SERVICE

- (a) Any utility service that enters VA property to the VA service equipment shall be installed underground in a concrete-encased duct bank.
- (b) Primary (medium-voltage) service is preferred. The service voltage should not exceed 15 kV. The use of higher voltages up to 35 kV will be considered for approval by VA, if cost effective and in compliance with the utility company's rules and regulations.
- (c) The preferred utility service for Mission Critical facilities is two primary sources, preferably from utility sources as electrically and physically separated as possible. Refer to the Physical Security Design Manual for more information. Provide a cost opinion for the second utility service, to aid VA in determining the cost effectiveness of this requirement. For non-Mission-Critical facilities, a single primary source is adequate; consider two utility sources if utility reliability is in question and it can be justified as cost effective.

Ensure that required easements for utility conductors and equipment are provided in accordance with the requirements of the serving utility.

5.2 PRIMARY DISTRIBUTION

5.2.1 GENERAL

- (a) Distribution topology shall be typically be primary selective, secondary radial. Primary radial systems are acceptable with VA approval for non-Mission Critical facilities.
- (b) Refer to Appendix B - Drawings for possible system topologies. These diagrams are intended for general design guidance purposes, and are not a basis of design for specific projects.
- (c) Refer to the Physical Security Design Manual for more information.

5.2.2 PRIMARY SWITCHGEAR

- (a) Primary switchgear for Mission Critical facilities shall be located indoors, in a secure, protected location that complies with the Physical Security Design Manual. The area shall have the necessary ventilation or cooling systems to maintain indoor temperature as required for proper operation of the equipment, as well as access control. Equipment shall be located above the Base Flood Elevation.
- (b) Primary switchgear for Mission Critical facilities shall be metal clad. Circuit protective devices shall be electrically operated, draw-out type circuit breakers with electronic relays for all Mission Critical facilities. Fused switch switchgear is acceptable for indoor and outdoor use at non-Mission Critical facilities. Refer to the Physical Security Design Manual for feeder protection and routing requirements.
- (c) Primary switchgear for non-Mission Critical facilities may be located outdoors, and may be padmounted fused-switch type.

5.2.3 PRIMARY CABLING

- (a) Primary cabling shall be installed underground, in concrete-encased ductbanks. Each ductbank shall contain ducts for planned future expansion, as well as 25% additional for unplanned future expansion. Route ductbanks to avoid possible locations of future building foundations or other structures. To the extent practical, normal and standby power feeders should be physically separated and not routed in the same ductbank.
- (b) Consider the use of 15kV cable for 5kV projects.

5.2.4 BUILDING PRIMARY-VOLTAGE DISCONNECTING MEANS

If a building contains more than one substation, and the substations are not located in a common room, provide air switches as necessary so that all power to the building can be disconnected from a common location.

5.3 SECONDARY DISTRIBUTION

5.3.1 GENERAL

Healthcare, Research, Clinical and Ambulatory Care Facilities and Essential Buildings with 1000 kVA or Larger Demand Load: The total building load (calculated demand kVA plus future growth) should be served by multiple single-ended unit substations. Low-voltage feeders between buildings shall be underground.

5.3.2 MEDIUM-TO-LOW VOLTAGE TRANSFORMERS

- (a) The maximum transformer size for 208Y/120V systems is to be 750kVA. The maximum transformer size for 480Y/277V systems is to be 2500kVA. Transformers may be dry or liquid-filled.
- (b) Outdoor padmounted transformers are permitted for non-Mission Critical facilities.

5.3.3 LOW VOLTAGE TRANSFORMERS

The A/E shall consider harmonic-mitigating dry-type transformers to serve building areas rich in non-linear loads.

5.3.4 SWITCHBOARDS, SWITCHGEAR, AND MOTOR CONTROL CENTERS

- (a) Provide switchboards, switchgear, and motor control centers with 25% space for additional overcurrent protective devices. Horizontal bussing should be fully rated for length of switchboard.
- (b) As a guideline, power circuit breakers are preferred for 1600A and above; molded case circuit breakers below 1600A. Select electronic trip functions for low-voltage circuit breakers so as to achieve selective coordination.

5.3.5 PANELBOARDS

Provide panelboards with 30% space for additional circuit breakers.

5.3.6 TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS)

- (a) Transient voltage surge suppression (TVSS) is mandatory for buildings equipped with a lightning protection system.
- (b) Integrated, cascaded TVSS is mandatory at all Mission Critical buildings, at the highest secondary voltage ("service entrance") level, at downstream panelboards that serve sensitive electronic equipment, and at individual receptacle locations by the use of TVSS receptacles. TVSS is encouraged at these locations in non-Mission-Critical buildings.

5.3.7 LOADS FED FROM UNINTERRUPTIBLE POWER SUPPLY (UPS)

- (a) UPS equipment is necessary for electronic or other equipment that performs critical functions and that requires continuous regulated power for operation.
- (b) As a minimum, the following loads should be protected by UPS equipment: Main Computer Room equipment, Telephone Equipment Room equipment, telecommunications equipment, HVAC control equipment, and any other mission-essential equipment that is not tolerant of the transfer time between utility and generator power and that is necessary for continuity of service.
- (c) UPS equipment should be arranged so that the required runtime is achieved by paralleled combinations of shorter-runtime battery cabinets.

5.4 POWER MONITORING AND METERING

5.4.1 GENERAL

- (a) Power monitoring and metering are in addition to utility metering.
- (b) At a minimum, power monitoring and metering equipment should be provided for medium-voltage switchgear on each main and distribution feeder circuit breaker, unit substation transformer secondary low-voltage main circuit breakers, generator paralleling switchboards, plug-in busways, and low-voltage switchboards and major distribution panelboards, for both normal and essential electrical systems. The power monitoring and metering system shall have the capability of communication with a VA centralized remote metering station via a data backbone.
- (c) At a minimum, power monitoring and metering equipment shall record, store, and trend voltage, current, kW, kWh, kVA, kVAR, power factor, and voltage and current total harmonic distortion.

5.4.2 ENERGY CENTERS

- (a) Provide power monitoring and metering for chilled water plants and boiler plants.

- (b) If medium-voltage chillers are used, install power monitoring equipment for each chiller.

5.4.3 EXISTING FACILITIES

If feasible, renovation projects should install power monitoring equipment on any major electrical equipment directly affected or modified by the work.

5.5 ELECTRICAL ROOMS AND CLOSETS

5.5.1 GENERAL

- (a) An electrical room is an area located within a building or structure which contains one or more of the following: medium-voltage switchgear, medium-to-low-voltage transformers, low voltage transformers, low-voltage distribution equipment, and panelboards. An electrical closet is an area located within a building that contains one or more of the following: low voltage transformers and low-voltage distribution and branch circuit panelboards.
- (b) The location, protection, and access to electrical room and closets shall comply with the Physical Security Design Manual.
- (c) Electrical rooms shall be located above the Base Flood Elevation. Electrical rooms shall not be located beneath toilets, showers, laboratories, kitchens, sinks, open courtyards, planters, roof drain leaders, or other areas where water service is provided.
- (d) Electrical equipment spaces shall be designed to allow maintenance equipment access, and to facilitate equipment replacement without significant demolition and reconstruction.
- (e) Any pipe or duct system foreign to the electrical installation shall not enter or pass through an electrical space. The A/E shall ensure that foreign piping such as water pipes, steam pipes, medical gas pipes, sanitary waste pipes, roof drains, A/C ducts and other unrelated piping systems containing liquids or gases are not installed or pass through electrical rooms. Sprinkler piping shall not be routed through electrical rooms, unless it serves to protect the electrical installation.
- (f) Electrical spaces shall have the necessary mechanical ventilation or cooling system to maintain the indoor temperature range required for proper operation of the equipment.
- (g) No telecommunications equipment, other than telecommunications outlets, shall be placed within electrical rooms.
- (h) Provide appropriate construction for the type of transformer(s) installed.
- (i) Electrical closets shall stack vertically, and shall not be further than 150 ft. [46m] apart, to limit maximum 120V circuit length to approximately 75 ft. [23m].

5.5.2 SPACE FOR FUTURE EQUIPMENT

- (a) Rooms that contain freestanding electrical equipment shall be sized so that sufficient space is provided to add one additional section to each unit of freestanding equipment. Provide extended pad space and spare conduits that will facilitate future installation of equipment and conductors. Spare space shall be indicated on drawings.
- (b) Electrical closets shall have 20% spare wall space for future installation of similar electrical equipment.

5.6 ELECTRICAL FACILITIES FOR OPERATING ROOMS

- (a) Refer to Design Guides (PG-18-12), Surgical Series.
- (b) VA no longer installs new isolated power systems. Refer to VHA Directive 2008-011. This Directive can be accessed on the VA TIL website.

5.7 ELECTRICAL FACILITIES FOR ELEVATORS

Refer to Transport Systems Design Manual for Hospital Projects. This manual specifies power, lighting, and telecommunications requirements for elevator machine rooms and hoistways.

This page intentionally left blank.

CHAPTER 6: LIGHTING

6.1	GENERAL	6-3
6.2	STANDARDS	6-3
6.3	LIGHTING CALCULATIONS	6-3
6.4	LIGHTING FIXTURE SCHEDULE	6-3
6.5	DESIGN APPROACH	6-3
6.5.1	DEVIATIONS	6-3
6.5.2	LIGHTING SCHEMES	6-3
6.6	LIGHT SOURCES	6-4
6.6.1	STANDARDIZATION OF SOURCES	6-4
6.6.2	FLUORESCENT	6-4
6.6.3	METAL HALIDE	6-4
6.6.4	LED	6-4
6.7	BALLASTS	6-4
6.8	FIXTURES	6-4
6.9	CONTROL	6-5
6.9.1	GENERAL	6-5
6.9.2	INTERIOR LIGHTING CONTROL	6-5
6.9.3	EXTERIOR LIGHTING CONTROL	6-6
6.10	INTERIOR LIGHTING	6-6
6.10.1	GENERAL	6-6
6.10.2	SPECIFIC APPLICATIONS	6-6
6.10.3	BEDROOM LIGHTING	6-7
6.10.3.1	General Lighting	6-7
6.10.3.2	Bed Lights	6-7
6.10.3.3	Vestibule Lighting	6-8
6.10.3.4	Service Alcove	6-7
6.10.3.5	Bedroom Lavatory	6-8
6.10.3.6	Night Light	6-8
6.10.3.7	Toilet/Bathroom	6-8
6.10.3.8	Closets or Lockers	6-8
6.10.4	CORRIDOR LIGHTING IN NURSING HOMES AND GERIATRIC AREAS (NOT DOMICILIARY)	6-8
6.10.5	EYE EXAMINATION ROOMS	6-8
6.10.6	HEMODIALYSIS EXAM	6-9
6.10.7	INTERSTITIAL SPACES	6-9
6.10.8	KITCHEN HOOD	6-9
6.10.9	POOL LIGHTING	6-10
6.10.10	ANIMAL WARD	6-10
6.10.11	PARKING GARAGES	6-10
6.10.12	ELEVATOR HOISTWAYS	6-10
6.11	EXTERIOR LIGHTING	6-10
6.11.1	GENERAL	6-10
6.11.2	EXISTING SITES	6-11
6.11.3	OBSTRUCTION LIGHTING	6-11
6.11.4	PARKING LOTS	6-11

This page intentionally left blank.

6.1 GENERAL

This chapter covers the lighting requirements for VA facilities.

6.2 STANDARDS

Use IESNA standards for general guidance of a lighting design, and for lighting situations that are not covered by this chapter. Allowed Lighting Power Density (LPD) figures shall follow ASHRE 90.1.

6.3 LIGHTING CALCULATIONS

- (a) Perform all lighting calculations based on the illumination levels in [Appendix A](#), Illumination Levels. Where illumination level are not provided, refer to IESNA Lighting Handbook, latest edition, for specific applications.
- (b) Calculations are not part of the contract documents. Calculations as a minimum shall include room name, room number, fixture type chosen for the room, number and type of lamps to be used in the room, required illumination level (VA or IESNA), calculated illumination level, and all light loss and reflectance assumptions used.
- (c) Calculations for most interior spaces may be performed using the zonal cavity method. Perform and submit point-by-point calculations for areas of greater architectural or luminous sophistication.
- (d) Calculations for exterior spaces, including parking structures, shall be point by point.
- (e) Calculations shall include demonstrated compliance with energy conservation measures as outlined in Chapter 1 of this Manual.

6.4 LIGHTING FIXTURE SCHEDULE

Provide a Lighting Fixture Schedule on the drawings, not as part of the specifications. Lighting Fixture Schedule shall state information such as fixture designations used on the plans, lighting fixture descriptions, exact lamp type, lamp quantity, wattage per lamp, etc.

6.5 DESIGN APPROACH

6.5.1 DEVIATIONS

Whenever deviations from VA Standards and/or Design Guides occur, the A/E shall make recommendations applicable to that specific project.

6.5.2 LIGHTING SCHEMES

At least two (2) proposed lighting schemes for special or architecturally unique areas (Visitor Lobbies, Cafeterias, Atriums, etc.) should be provided. Layouts shall vary in concept and materials such as fixture layout, fixture type, lamps, louvers, reflectors, etc. This will enable VA to select the best scheme to suit project goals and budget requirements.

6.6 LIGHT SOURCES

6.6.1 STANDARDIZATION OF SOURCES

Standardize lamp types across fixture types to limit the number of different lamp types and wattages used.

6.6.2 FLUORESCENT

- (a) Linear 2 ft. and 4 ft. T8 fluorescent lamps with CRI>70 and rated lifespan of 20,000 hours are the preferred interior lighting source. T5 2 ft. and 4 ft. double-ended linear sources are allowed for indoor locations. Compact fluorescent lamps in twin-, tri-, and quad-tube T4 configurations are allowed.
- (b) Color-corrected lamps having a CRI of 85 or above and correlated color temperature between 5000 degrees K and 6000 degrees K are required in the following areas:
 - Over ICU beds
 - Over CCU beds
 - Over Recovery Room beds
 - Over Life Support beds
 - Over Observation and Treatment beds
 - Electromyographic Rooms
 - Autopsy (Necropsy) Rooms
 - Surgery Rooms (color shall match that of the surgical light)
 - Dental Rooms (Examination, Oral Hygiene, Oral Surgery, Recovery, Labs, Treatment and X-ray)

6.6.3 METAL HALIDE

Use pulse-start ballasts, and pulse-start lamps with glass or ceramic arc tubes. Probe-start ballasts and lamps are not acceptable.

6.6.4 LED

When the A/E demonstrates LED lighting to be cost-effective, LED lighting will be considered by the VA for task-focused applications on a project-specific basis.

6.7 BALLASTS

Electronic high-frequency type ballasts shall be used for all linear fluorescent lamps. Low-frequency hybrid electronic-electromagnetic ballasts that operate lamps at 60Hz may be considered for surgery rooms, critical care units, and animal labs.

6.8 FIXTURES

- (a) Select fixtures and light sources with long operating lives; which utilize controlling elements (lenses, louvers, reflectors, etc.) designed to provide the best utilization of emitted light at the task location; that are appropriate for the ambient temperature; and that are not prone to dirt accumulation.

- (b) In high ceiling areas, locate fixtures for maintenance access or provide access for maintenance equipment.

6.9 CONTROL

6.9.1 GENERAL

- (a) Energy consumption constraints dictate the installation of automatic lighting controls for both interior and exterior lighting. The A/E shall select and design master and room-specific lighting control systems that comply with energy codes and requirements; that respond to daylight harvesting; that utilize the correct sensor and sensor location for the controlled space; that are compatible with the controlled ballasts and lamps; and that are responsive to the occupant's desire not to feel 'over-controlled.'
- (b) For projects that employ indoor and/or outdoor occupancy and light sensors, provide a schedule on the drawings for room or area name, sensor type (i.e., ultrasonic, infrared, dual-technology, photoelectric, etc.), light level, detection coverage, interface with automatic lighting control and building HVAC systems, and any other control parameters necessary to indicate the lighting control requirement.

6.9.2 INTERIOR LIGHTING CONTROL

- (a) For fixtures with three, four or more lamps, switch the lamps symmetrically for two (or three) lighting levels.
- (b) In large administrative areas along the windows, provide bi-level switching for lighting fixtures located within 15 feet from the windows. The rest of the lighting fixtures shall be switched with separate switches.
- (c) Where multiple room entrances are not immediately adjacent to each other, provide three- or four-way switching.
- (d) Utilize low-voltage switching in large areas with multiple entrances, such as large auditoriums or meeting centers over 10,000 square feet.
- (e) Utilize low-voltage switching in large areas to control illumination separately at logical work station locations, such as General Laboratories, Pharmacy areas, Shops, etc.
- (f) Install dual technology occupant sensor (ultrasonic/infrared) controls for room lights in Public Toilets, Conference Rooms, Day Rooms, Examination Rooms and similar spaces. Occupancy sensor controls shall be considered for all non-emergency egress lighting fixtures located in non-patient care corridors.
- (g) Bed ward corridor lighting shall be controlled from the Nurse Station.
- (h) In relatively large, infrequently used rooms such as crawl spaces, pipe spaces, interstitial spaces, attics, etc., where lights can be left on unnoticed, install a pilot light outside the area which indicates when the lights are on.

- (i) Lighting control panels with astronomical timeclocks shall be used in non-patient areas such as administrative area, animal lab areas, and warehouse. By-pass switches variable from ½ to 2 hours shall be provided as part of the entire lighting control system.

6.9.3 EXTERIOR LIGHTING CONTROL

Typically, control exterior lighting by photoelectric controls integral with each fixture. Selected circuits may be additionally controlled by astronomical time switches if approved by the VISN Safety Officer.

6.10 INTERIOR LIGHTING

6.10.1 GENERAL

Use VA illumination levels as design values and not as minima. Select the number of lamps and the fixture type according to the recommended finishes specified in each area to ensure the intended lighting levels.

6.10.2 SPECIFIC APPLICATIONS

- (a) Use semi-iridescent parabolic louver fixtures in offices, nurse stations, and similar spaces where CRT equipment is commonly used.
- (b) In offices, examination rooms and similar spaces with non-fixed task locations which require 30 fc or greater, position ends of fluorescent fixtures (or rows) within 2.5 ft. [750mm] of abutting walls. Select fixtures and lamp quantities to provide the required lighting level.
- (c) Eliminate lighting fixtures from established general lighting layouts designated as non-task areas such as aisle space or other traffic locations in front of doorways. Eliminate the fixture for rooms over 100 sq. ft. [9 sq. m] if a door swing arc intercepts a lighting fixture on the floor plans.
- (d) Instead of using the ceiling system, run continuous rows of fluorescent fixtures centered over the front edge of wall-mounted benches and crosswise to double-sided benches in laboratories, pharmacies, shops and similar areas having work tables and benches. Eliminate or reduce the number of fixtures over open floor areas.
- (e) Provide fluorescent over-mirror lights in all toilets. The fixture length does not need to be confined to the width of the mirror. Size the fixture to double as general illumination in the case of small toilets. If a bathtub or shower is included, install a ceiling light.
- (f) In storage, shelf or stack areas, mount fixtures in rows lengthwise over aisles between rows of shelves to make the most efficient use of the lighting. In areas over 400 sq. ft. [37 sq. m], consider running continuous fixture rows at 45 degrees to the general room dimensions, coordinating the layout with the ceiling system design.
- (g) Decorative lighting for lobbies, waiting rooms, patios, auditoriums, chapels, etc., shall use energy efficient light sources. Decorative lighting power consumption shall be calculated in the allowed lighting power density for energy saving purposes.

- (h) Patient-area corridors shall be illuminated with lensed or indirect fixtures.
- (i) For public toilets that have more than three toilet stalls, at least one ceiling/wall mounted emergency battery lighting unit with dual head, or one 4-ft. T8 lamp in a fluorescent lighting fixture connected to emergency power battery ballast, shall be provided. Batteries are not necessary where at least one 4-ft. T8 lamp is connected to the Life Safety Branch of the Emergency System.

6.10.3 BED ROOM LIGHTING

6.10.3.1 General Lighting

- (a) None required for single-bed rooms; provided by bed light, up-light and spill light from vestibule lighting.
- (b) In rooms with two or more beds, provide a separate fluorescent fixture near the open floor area (outside curtain tracks) or other fixture type suitable to room conditions. If the center floor area is not available, use fixtures on each side of the obstruction. Control by switch inside corridor door.

6.10.3.2 Bed Lights

- (a) 120V fluorescent wall bracket fixture with two lamps for up-light and two lamps for down-light for reading. The fixture should be totally patient-controlled with a four-position pull-cord switch (up-down-both-off). Exception: Single-bed rooms shall have up-light controlled from switch inside room entrance.
- (b) In bedrooms with lavatories, provide a pull-cord for total patient control. See [Article 6.10.3.6 "Bedroom Lavatory"](#) below.
- (c) Fluorescent fixture parallel to and centered over each bed. Control from switch in PBPU (or bedwall when PBPU is not employed). Provide label for the switch with ¼ in. [6mm] engraved letters "OVERBED LIGHT" on PBPU or the wall plate.
- (d) Intensive Care Units: Fluorescent fixture parallel to and centered over each bed, controlled by combination dimmer/switch outside of door to bed cubicle or Isolation Room. Include 3-way switch at vicinity of Nurse Station.
- (e) Domiciliary and Mental Health and Behavioral Nursing Units-Over-Bed: Over-bed and task lighting is not required.

6.10.3.3 Vestibule Lighting

Fluorescent fixture for single-bed and multi-bed rooms located at entrance to bedroom, controlled by switch inside corridor door.

6.10.3.4 Service Alcove

Fluorescent wall bracket fixture over mirror, controlled by switch inside corridor door or adjacent to alcove, as appropriate.

6.10.3.5 Bed Room Lavatory

Fluorescent wall bracket fixture over mirror, controlled by switch inside corridor door. Provide 3-way switch near lavatory when lavatory is more than 10 ft. [3m] from the corridor door.

6.10.3.6 Night Light

- (a) Fluorescent or LED fixture, wall mounted 18 in. [450mm] above the floor and located to primarily illuminate the circulation area between the bed(s) and the toilet or service alcove. Control locally by switch. Control night light circuit(s) through simple 24-hour master timer, or automatic lighting control system. Exception: In ICU cubicles, control by wall switch at entrance to the cubicle and delete the local switch.
- (b) Intensive Care Units: Fluorescent or LED fixture, wall mounted 18 in. [450mm] above the floor and located to illuminate the primary circulation area of the bed cubicle or Isolation Room. Control by switch inside the bed cubicle or Isolation Room door.

6.10.3.7 Toilet/Bathroom

Fluorescent fixture wall-mounted over mirror. Where bathtub or shower is included, use a fluorescent ceiling light in addition to the mirror light. A wet-location shower light may also be required. Control by switch(es) inside the room door(s).

6.10.3.8 Closets Or Lockers

Place fixtures appropriately for adequate lighting in closets and lockers.

6.10.4 CORRIDOR LIGHTING IN NURSING HOMES AND GERIATRIC AREAS (NOT DOMICILIARY)

- (a) Design lighting to minimize both direct and indirect glare in the eyes of the elderly and visually impaired. Use appropriate indirect fluorescent lighting that is efficient, easily serviceable, and does not collect excessive amounts of dust.

6.10.5 EYE EXAMINATION ROOMS

- (a) Provide fluorescent lighting fixtures with dimming ballasts and the following controls in each Eye Exam Room in the Eye Clinic:
 - One 3-way dimmer switch at the strike side of the entrance door.
 - One 3-way dimmer switch on the side wall near the expected location of the projection screen.

- One 4-way floor switch, foot operated, with approved rubber-insulated cable, approximately the diagonal length of the room exposed on floor. Extend this switch from a recessed junction box mounted 6 in. [150mm] above the finished floor to clear the base molding.

6.10.6 HEMODIALYSIS EXAM

In addition to a fluorescent fixture (two-level switch) over each patient lounge bed, provide a compact fluorescent downlight over both sides of the lounge bed. Control by dimmer control at the bed wall.

6.10.7 INTERSTITIAL SPACES

- (a) Install fluorescent strip lights equipped with wire guards.
- (b) Spaces with walkways or catwalks only:
 - Locate fixtures appropriately along catwalks and walkways.
 - Select a few appropriate fixtures to be on an unswitched emergency circuit.
 - Switch all non-emergency powered fixtures from all access doors to the space. Long catwalk runs should be separately switched.
- (c) Spaces with "walk-on" floors:
 - Provide general lighting to avoid piping, ductwork and equipment, with emphasis at walkways.
 - Select a few appropriate fixtures to be on an unswitched emergency circuit.
 - Switch all non-emergency powered fixtures locally by bays (or groups) and at each access door. Walkway lights should be switched at all related access doors. Use low-voltage remote control switching to extinguish all non-emergency general lighting from every access door to the space.
- (d) Provide a small red pilot light over the outside of each access door to the interstitial space indicating when the switched lighting is on.
- (e) Locate exit lights inside the access door to the interstitial space at a point 4 ft. [1.2m] above the finished floor and approximately 6 in. [150mm] horizontally from the access door frame. Provide exit lights with metal stencil face type to minimize breakage. Provide additional directional signs, if the path or route to the access door(s) is particularly circuitous.
- (f) Connect all or part of the lighting in Equipment Rooms at the interstitial floor level on emergency circuits. In the smaller Equipment Rooms, the emergency lighting should be switched at the doors as with all other fixtures. In large Equipment Rooms, a few select emergency fixtures should be unswitched, and the rest switched from inside the door(s) and monitored by pilot light outside the door(s).

6.10.8 KITCHEN HOOD

Control fixtures integral with hoods to operate when the hood exhaust system operates.

6.10.9 POOL LIGHTING

- (a) The lighting of therapeutic pools should minimize glare on the water. Use fluorescent or metal halide sources in moisture-resistant lighting fixtures mounted above or at a high angle as viewed from the pool. Do not mount lighting fixtures directly over the pool unless they can be serviced from above.
- (b) Provide underwater lighting from low-voltage fixtures in wet niches in pool walls. Underwater lights should supplement the spill light from the overhead apron lighting to provide clear visibility of persons in the pool.

6.10.10 ANIMAL WARD

- (a) Design lighting systems in accordance with “Guide for the Care and Use of Laboratory Animals” published by the Institute of Laboratory Animals Resources.
- (b) Provide uniformly spaced rows of enclosed and gasketed fluorescent fixtures. Rows are to be over both cage and aisle locations. Locate a similar type fixture over the sink/counter area and control by a separate wall switch.
- (c) Animal housing room lighting shall be controlled by a lighting control panel with astronomical time clock and by-pass switches variable from ½ to 2 hours. Mount all controls on wall outside of the room door.

6.10.11 PARKING GARAGES

Criteria recommended in the IESNA Guideline for Security Lighting for People, Property, and Public Spaces (latest edition) shall govern the lighting design. Provide suitable and cost efficient lighting such as fluorescent, high pressure sodium, or metal halide. Do not use low-pressure sodium. Lighting fixtures should limit spill light and excessive glare to adjacent private and public property.

6.10.12 ELEVATOR HOISTWAYS

Refer to the Automatic Transport Design Manual for Hospital Projects.

6.11 EXTERIOR LIGHTING**6.11.1 GENERAL**

- (a) Generally, exterior lighting shall comply with energy requirements, and should comply with Dark Sky principles. When required by VA, exterior lighting designs are to meet the requirements of local outdoor lighting codes. Criteria recommended in the IESNA Guideline for Security Lighting for People, Property, and Public Spaces (latest edition) shall govern the lighting design. Refer also to Appendix A.
- (b) Exterior lighting shall be coordinated with physical security, CCTV, and landscaping requirements.

- (c) White light sources are preferred near buildings. Sodium lighting may be used for parking areas. Exterior decorative lighting shall not be used for general illumination.
- (d) Minimize direct light onto windows; direct and reflective (disabling) glare; and spill illumination onto adjacent properties (use house-side shields when adjacent to residential property).
- (e) Include conduits, and mounting provisions in pole bases and on poles, for camera or other security equipment as required.
- (f) Provide complete pole base details on plans. Details shall indicate complete structural and electrical elements such as rebars, type of concrete, anchors, conduits, handholes etc. Structural elements shall be designed by a licensed structural engineer to meet all local structural conditions, such as seismic zone, soils, wind loading, etc.

6.11.2 EXISTING SITES

At existing sites, new fixtures and sources shall match the existing exterior fixtures. Provide details and/or manufacturer's name and catalog number, if possible.

6.11.3 OBSTRUCTION LIGHTING

Where required, implement obstruction lighting by Federal Aviation Administration (F.A.A.) Advisory Circular AC 70/7460-1K, Obstruction Marking and Lighting, latest edition.

6.11.4 PARKING LOTS

- (a) Illuminate large parking lots with pole-mounted cutoff fixtures, using alternate circuiting. High-wattage pole- or building-mounted floodlights are discouraged. The maximum height of a pole shall be 40 ft. [12m]. Coordinate locations with snow removal means, and hardscape and landscape features, including projected tree growth. A combination of exterior-wall-mounted and pole-mounted fixtures may be used for illumination of small parking lots.
- (b) Provide minimum maintained illumination levels for bicycle and pedestrian pathways, vehicle routes, parking lots, wayfinding, signage, pedestrian entrances, and building surrounds and services which will provide safety and security.
- (c) Preferred pole locations are islands and landscaped areas beyond the reach of vehicle bumpers. When not practical, extend concrete base 30 in. [760mm] above finished grade.
- (d) Match existing pole/fixture/source styles in renovation or addition projects.
- (e) Consider corrosion protection when selecting materials and finishes.

This page intentionally left blank.

CHAPTER 7: TELECOMMUNICATIONS CABLE PATHWAYS, WIRING AND CABLES, AND
INFRASTRUCTURE PLANT; AND SPECIAL TELECOMMUNICATIONS SYSTEMS

CHAPTER 7: TELECOMMUNICATIONS CABLE PATHWAYS, WIRING AND CABLES, AND
INFRASTRUCTURE PLANT; AND SPECIAL TELECOMMUNICATIONS SYSTEMS

7.1	SCOPE	7-3
7.2	GENERAL REQUIREMENTS	7-3
7.2.1	TELECOMMUNICATIONS INFRASTRUCTURE PLANT (TIP)	7-3
7.2.2	TIP FUNCTIONAL REQUIREMENTS	7-4
7.3	CONDUITS AND BOXES	7-4
7.3.1	GENERAL	7-4
7.3.2	MINIMUM SIZE	7-4
7.3.3	INTERCONNECTING CONDUIT REQUIREMENTS	7-4
7.3.4	HORIZONTAL CONDUITS.....	7-6
7.3.5	PARTITIONED CABLE TRAYS AND OPEN WIREWAYS.....	7-6
7.3.6	TELECOMMUNICATIONS CABLE DUCTS UNDER CELLULAR FLOORS	7-7
7.3.7	VERTICAL RISERS	7-7
7.4	TELECOMMUNICATIONS OUTLETS	7-7
7.5	DRAWINGS.....	7-8
7.6	WIRES AND CABLES	7-8
7.7	SPECIAL SYSTEMS SPECIFIC REQUIREMENTS.....	7-9
7.7.1	GENERAL	7-9
7.7.2	NURSE CALL	7-9
7.7.3	PUBLIC ADDRESS (PA)	7-9
7.7.4	INTERCOMMUNICATION SYSTEM (IC).....	7-9
7.7.5	MASTER ANTENNA TELEVISION (MATV).....	7-10
7.7.6	MOTION INTRUSION DETECTION (MID).....	7-10
7.7.7	CLOSED CIRCUIT TELEVISION (CCTV).....	7-10
7.7.8	ELECTRONIC ACCESS AND DOOR CONTROL (EADR)	7-10
7.7.9	RADIO PAGING SYSTEM (RPS).....	7-11
7.7.10	PATIENT/STAFF ANNUNCIATOR/LOCATOR SYSTEM (PAL)	7-11
7.7.11	TWO - WAY RADIO SYSTEM.....	7-11
7.7.12	DURESS ALARM AND EMERGENCY NOTIFICATION SYSTEM	7-11
7.7.13	SECURITY MANAGEMENT AND CONTROL, AND CENTRALIZED POLICE SECURITY MANAGEMENT SYSTEMS	7-11
7.7.14	PATIENT ANNUNCIATOR/LOCATOR SYSTEM (PAS)	7-12

CHAPTER 7: TELECOMMUNICATIONS CABLE PATHWAYS, WIRING AND CABLES, AND
INFRASTRUCTURE PLANT; AND SPECIAL TELECOMMUNICATIONS SYSTEMS

This page intentionally left blank.

CHAPTER 7: TELECOMMUNICATIONS CABLE PATHWAYS, WIRING, CABLES, AND INFRASTRUCTURE PLANT; AND SPECIAL TELECOMMUNICATIONS SYSTEMS

Note: Chapters 7 & 8 contain like references, guidelines and instructions that refer to each specific system/function. These "like" descriptions have been cross-referenced throughout both chapters to reduce redundancy. Additionally, each chapter contains acronyms that universally relate to each; and thus, both have been combined in the beginning of Chapter 7.

7.1 SCOPE

- (a) This section covers requirements for cable pathways and raceways, wiring and cables, Telecommunications Infrastructure Plant (TIP) and special telecommunications systems (hereinafter referred to as "Special Systems") for all VA facilities.
- (b) Cable pathways, raceways, wiring and cables are a part of and make up the TIP. The TIP shall, at a minimum, incorporate all telephone, data, and special systems cables.
- (c) Special Systems are identified as those telecommunications systems that are not telephone (aka 'voice'), data or fire alarm (or related functions).
- (d) Contact VA Telecommunications Voice Engineering Division (TVE-005OP3B – 301-734-0350) for technical assistance with systems design and preparation of construction documents and proof of performance testing and VA certification.

7.2 GENERAL REQUIREMENTS

7.2.1 TELECOMMUNICATIONS INFRASTRUCTURE PLANT (TIP – VA identified as 'Real Property' of a Facility, Building or Project)

- (a) Provide TIP system(s) and interfaces/interconnections and wire management functions as required. In renovation projects, the TIP shall be compatible with and extend the facility's existing TIP. Refer to Master Specifications sections 27-10-00, 27-11-00 and 27-15-00 for specific technical, installation and Service Category 5E requirements.
- (b) All TIP wire and cabling shall be installed in a raceway system, which may consist of a mixture of conduits, enclosed cable trays, open wireways, covered cable ducts, National Recognized Testing Laboratory (NRTL)-approved partitioned communications wireways, and/or cable ladders, except as specifically approved by TVE- 005OP3B.
- (c) All TIP wire and cabling shall be installed in drop ceiling using cable hangers and wire basket cable tray. In hard ceiling areas a raceway system, which may consist of a mixture of conduits and enclosed cable trays is required.
- (d) TIP wires or cables may be provided inside gypboard walls in flexible conduit, as specifically approved by the Facility's Chief Engineer, in writing, for each specific location.

7.2.2 TIP FUNCTIONAL REQUIREMENTS

- (a) All TIP construction documents are required to be reviewed and technically approved by TVE-005OP3B before being released for bidding and construction
- (b) The term "provide", where used herein, shall mean the same as "designed, engineered, furnished, installed, tested, guaranteed, and certified by the contractor."

7.3 CONDUITS AND BOXES

7.3.1 GENERAL

For system conduits, junction boxes, routing, termination, risers, horizontal runs, sizing, etc., follow industry-standard requirements.

7.3.2 MINIMUM SIZE

- (a) Conduit from outlet to above ceiling should be a minimum of one (1) inch.
- (b) Conduit runs outside buildings will be equipped with a pull box (inside) or manhole (outside) after two 90-degree bends or an accumulation of 120-degrees of total pathway deviations from a straight line between each point of access.
- (c) Conduits outside of buildings shall be waterproof and shall not exceed 400 ft. [122m] between manholes or pull boxes (not counting bend or traverse loss).
- (d) Conduit runs shall be routed to the nearest wireway, cable tray, interface cabinet or rack when installed in interstitial spaces.

7.3.3 INTERCONNECTING CONDUIT REQUIREMENTS

- (a) The A/E may refer to oneline drawing of suggested telecommunications topology in Appendix B for a graphical representation. The following table identifies the minimum conduit requirements for the TIP infrastructure:

CHAPTER 7: TELECOMMUNICATIONS CABLE PATHWAYS, WIRING AND CABLES, AND
INFRASTRUCTURE PLANT; AND SPECIAL TELECOMMUNICATIONS SYSTEMS

Table 7-1 Conduit Requirements

LOCATION A	LOCATION B	CONDUIT TYPE	QUANTITY	SIZE
Entrance A from street - Provider 1	Entrance Room A (DEMARC)	Direct burial PVC or PE	5*	4 in. [100mm]
Entrance B from street - Provider 2	Entrance Room B or A if only one Entrance Room used (DEMARC)	Direct burial PVC or PE	5*	4 in. [100mm]
ER (DEMARC)	Telephone Equipment Room (TER)	EMT	3**	4 in. [100mm]
ER (DEMARC)	Main Computer Room (MCR)	EMT	3***	4 in. [100mm]
ER (DEMARC)	Each Telecommuni- cations Room (TR) Vertical Riser Stack on TER Floor	EMT	2****	4 in. [100mm]
ER (DEMARC)	Head End Room (HER)	EMT	1	3 in. [75mm]
TER	Each TR Vertical Riser Stack on TER Floor	EMT	3*****	4 in. [100mm]
TER	Main Computer Room (MCR)	EMT	5	4 in. [100mm]
MCR	Each TR Vertical Riser Stack on the MCR Floor	EMT	3*****	4 in. [100mm]
MCR	Backup Computer Room (if provided)	EMT	3*****	4 in. [100mm]
Between TRs on same floor	Between TRs on same floor	EMT	Cable Tray	4 in. [100mm]
Stacked TRs	Next stacked TRs	EMT (sleeves)	6	6 in. [140mm]
TER	Telephone Console Room (TCR)	EMT	1	4 in. [100mm]
TER	Police Control Room (PCR)	EMT	1	4 in. [100mm]
TER	HER	EMT	1	2 in. [50mm]
MCR	TCR	EMT	1	3 in. [75mm]
MCR	PCR	EMT	1	4 in. [100mm]
MCR	Head End Room (HER)	EMT	1	2 in. [50mm]
HER	Roof or access to antennas	EMT (weather proofed)	2	3 in. [75mm]
HER	PCR	EMT	1	2 in. [50mm]
HER	ECR	EMT	1	2 in. [50mm]
MCR	ECR	EMT	1	2 in. [50mm]
TER	ECR	EMT	1	2 in. [50mm]

(b) Conduit Use / Designation

- * - 1 Ea. Voice, 1 Ea. Data, 1 Ea. Special Systems, 1 Ea. Security/Emergency systems, 1 Ea. Spare.
- ** - 2 ea. Voice, 1 ea. Spare.
- *** - 2 ea. Data, 1 ea. Spare.
- **** - 1 ea. Special Communications, 1 ea. Security/ Emergency systems.
- ***** - 2 ea. Voice, 1 ea. Spare.
- ***** - 2 ea. Data, 1 ea. Spare.

- (c)** Coordinate all conduit entrance locations with the facility staff and obtain written technical approval from TVE-005OP3B.

7.3.4 HORIZONTAL CONDUITS

- (a)** Basket type cable tray may be installed above suspended ceilings in corridors for station wiring in non-critical areas (i.e., outside surgery, recovery, ICU, etc.). Minimum size shall be 6 in. [150mm] wide with 1.5 in. [40mm] high ends.
- (b)** Surface metal raceways are not acceptable and will not be approved for wire or cable on the outside of walls.
- (c)** Conduit runs to and/or from backboards in a telecommunications room or interstitial space shall terminate at the top or bottom of the backboard. Conduits shall not cover any portion of the backboard.
- (d)** Horizontal runs of enclosed wireways are not acceptable for above ceiling applications. However, enclosed wireways are required in interstitial spaces.

7.3.5 PARTITIONED CABLE TRAYS AND OPEN WIREWAYS

- (a)** Unless otherwise specified, install all system TIP wiring and cabling in approved telecommunications partitioned cable trays, or open wireways as specifically approved by TVE-005OP3B.
- (b)** When permitted by NFPA, open wireways or partitioned cable trays may contain multiple telecommunications systems of like service. These combinations must be approved by TVE-005OP3B prior to the system design. The wireways or partitioned cable trays must be able to be mechanically protected and allow separation of the telecommunications cables by system.
- (c)** Open wireways or partitioned cable trays may be mounted vertically as long as they are attached to solid building structures and the wires or cables are protected, secured from falling out and separated from other systems.

CHAPTER 7: TELECOMMUNICATIONS CABLE PATHWAYS, WIRING AND CABLES, AND
INFRASTRUCTURE PLANT; AND SPECIAL TELECOMMUNICATIONS SYSTEMS

- (d) TIP wire and cable runs that are routed from open wireways and/or cable trays in interstitial spaces to the nearest vertically stacked TR, equipment HE room or telecommunications outlet shall be enclosed in conduit. However, the use of cable racks or ladders, installed from the TRs may be used above the ceiling for station cable installation in non-critical areas as long as each location's egress and ingress signal processing, radiation and electromagnetic interference (EMI) properties are maintained as described herein and approved by TVE-005OP3B prior to final system design.
- (e) The use of cable racks or ladders is not allowed for Special Systems certified for Life and Public Safety and Emergency Operations unless specifically approved by TVE-005OP3B2, in writing, prior to system design and installation.

7.3.6 TELECOMMUNICATIONS CABLE DUCTS UNDER CELLULAR FLOORS

- (a) Under floor ducts and/or cellular floors shall be considered as air plenum areas. Therefore, all system wires and cables provided in these areas shall be plenum rated and installed accordingly.
- (b) Each under floor cable duct and/or cellular floor installation shall be provided with appropriate TIP and electrical wire management system(s).
- (c) All under floor ducts and/or cellular floors must be extended to wall partitions in rooms where installed.

7.3.7 VERTICAL RISERS

- (a) The main horizontal conduit runs from the TER and MCR to each stacked TR shall be of the size, use and count described in Table 7.1, and shall penetrate the TR floor and terminate 18" AFF. Each floor penetration shall be sleeved and sealed with firestopping compound regardless if filled with wire/cable.
- (b) Each TR ceiling and corresponding floor of the above stacked TR shall be provided with sleeved penetrations of the size, use, and count described in Table 7.1. Each penetration shall be sealed with approved fire stopping compound regardless if filled with wire/cable.

7.4 TELECOMMUNICATIONS OUTLETS

- (a) Outlet boxes shall be the same minimum size as NEC standard 6 in. by 6 in. by 2.5 in. that will handle dual duplex type electrical outlets, recessed mounted to allow EMT or flexible conduit to terminate on them.
- (b) Outlet boxes shall be equipped with full covered wall faceplates that shall cover the entire box without trim rings added and employ two (2) ea. modular Category 5E RJ-45/11 jacks for voice, two (2) ea. modular Category 5E RJ-45 jacks for data. The box must also provide space for the addition of one (1) modular stainless steel (AT&T-ST) fiber-optic Jack and one (1) BNC (A/E Note: may be substituted for a "F" or "ST" types depending on system design) analog coax cable jack (for a total of six available modular jack positions).
- (c) Unless otherwise specified, mounting heights for telecommunication outlets shall be:

Table 7-2 Telecommunications Outlets Mounting Height

AREA/FUNCTION	MOUNTING REQUIREMENTS
Pay station	4 ft. [1.2m] above finished floor (AFF)
Desk outlet	18 in. [450mm] AFF
Special Use Areas	As required by A/E design and approved by TVE-005OP3B

- (d) Patient Bed Prefabricated Wall Units (PBPU) - use the provided receptacle box, conduit and connections in order not to violate the PBPU's UL Medical/Life Safety Certification. Violations of the units' UL certification must be corrected at the Contractor's expense.
- (e) Special Systems - provide each outlet minimum 18 in. [450mm] AFF unless otherwise specified by system design or indicated on the drawings.
- (f) Outlets shall not be located within 48 in. [1.2m] of the "swing open" side of inward opening doors or within 18 in. [450mm] of light switches, electrical receptacles, or thermostats.

7.5 DRAWINGS

- (a) The A/E shall clearly show the locations of TIP, telecommunications outlets, conduit runs, cable trays or wireways, equipment cabinets and/or racks, telecommunications backboards, and terminal, junction and/or pull boxes on the drawings. The drawings must clearly identify locations of these runs when both originating and terminating points are not shown on the same drawing.
- (b) The A/E shall clearly show the exterior and/or underground TIP raceway system, including distances between buildings, manholes, and in-ground pull boxes.
- (c) All raceways sizes shall be indicated on the drawings.
- (d) Drawings must include a detailed riser diagram for all distribution systems, and the interfaces between systems.

7.6 WIRES AND CABLES

- (a) The design of the raceway system in existing buildings shall incorporate the existing facility TIP raceway systems. All unused existing distribution wires, cables and pathway equipment not incorporated in the new or replacement pathway system shall be removed and disposed of at the direction of the Resident Engineer.
- (b) Plenum/CMP rated wire or cable shall be provided in all areas air-handling plenum locations. Non-plenum/CM wire or cable may be provided in all other areas.
- (c) Elevator voice cables providing voice service to the elevator car shall be extended to a terminal box located outside the elevator shaft, approximately midway of the maximum up/down travel range of the elevator car. The terminal box must be easily accessible from the internal hospital area and connected by 1.5 in. [40mm] conduit to the nearest telecommunications room. Provide the outlet in the car's standard telephone back box.

7.7 SPECIAL SYSTEMS SPECIFIC REQUIREMENTS

7.7.1 GENERAL

Provide systems described herein as determined by project requirements. Not all systems may be required, and not all required systems may be listed below.

7.7.2 NURSE CALL (VA identified as an Emergency/Life Safety System)

- (a)** Provide Nurse Call / Code Blue system(s) as required. Refer to VA Master Specification 27 52 23.
- (b)** Provide Emergency Nurse Call Stations in non-patient-ward toilet areas only at the following locations:
 - Dental Service (if not covered by a hands-free telephone intercom system)
 - Drug Dependency Treatment Clinic
 - Genitourinary Clinic
 - Nuclear Medicine
 - Oncology Clinic/Area (if not covered by a Nurse Call or Code One/Blue system)
 - Dialysis Clinic (if not covered by a Nurse Call or Code One/Blue System)
 - Radiology Clinic (if not covered by a Nurse Call or Code One/Blue System)
- (c)** Contact TVE-005OP3B for specific engineering design and technical approvals when a Nurse Call System is required for the facility.

7.7.3 PUBLIC ADDRESS (PA - VA identified as an Emergency Communications System and the Primary Code Blue Team Notification System)

- (a)** Provide PA and mass notification system(s) as required. Refer to VA Master Specification 27 51 16.
- (b)** Provide a PA system that includes a speaker volume control in each Multipurpose, Break and Recreation Room.
- (c)** Contact TVE-005OP3B for specific engineering design and technical approvals when a PA System is required for the facility.

7.7.4 INTERCOMMUNICATION (IC - VA identified as an Emergency Communications System)

- (a)** Provide intercommunications system(s) as required. Refer to VA Master Specification 27 51 23.
- (b)** At loading docks, provide an empty conduit system for connection of a telephone intercom.
- (c)** In the Dental Clinic, provide a dedicated IC system throughout the Dental area reporting to the Clinic's Administrative Desk. Telephone hands-free instruments may be substituted for a formal IC system as an acceptable alternate, if specifically approved by TVE-005OP3B during the project design phase.

CHAPTER 7: TELECOMMUNICATIONS CABLE PATHWAYS, WIRING AND CABLES, AND
INFRASTRUCTURE PLANT; AND SPECIAL TELECOMMUNICATIONS SYSTEMS

- (d) Provide appropriate IC systems at designated facility ingress and egress points connected to the Security Service Control Room.
- (e) Contact TVE-005OP3B for specific engineering design and technical approvals when an IC System is required for the facility.

7.7.5 MASTER ANTENNA TELEVISION (MATV)

- (a) Provide Master Antenna Television (MATV) system(s) that are High Definition TV (HDTV) compliant, as required. Refer to VA Master Specification 27 41 31.
- (b) Master Antenna system antennas shall be mounted on hinged poles (or equivalent) where subjected to salt-spray atmosphere.
- (c) Provide MATV outlets at ceiling or on the wall near patient beds. Verify type TV set (swing arm, ceiling or wall-mounted) to be used. Provide additional MATV wall/ceiling outlets mounted at designated areas.
- (d) Contact TVE-005OP3B for specific engineering design and technical approvals when a MATV System is required for the facility.

7.7.6 MOTION INTRUSION DETECTION (MID - VA identified as a Patient/Staff/Public Safety System)

- (a) Provide Motion Intrusion Detection (MID) system(s) as required. Refer to VA Master Specification 28 16 11.
- (b) Contact TVE-005OP3B for specific engineering design and technical approvals when a MID System is required for the facility.

7.7.7 CLOSED CIRCUIT TELEVISION (CCTV – VA identified as a Patient/Staff/Public Safety System when used for Police and Law Enforcement functions)

- (a) Provide Closed Circuit TV (CCTV) system(s) for door monitoring or security as required. Refer to VA Master Specification 28 23 00.
- (b) Contact TVE-005OP3B for specific engineering design and technical approvals when a CCTV System is required for the facility.

7.7.8 ELECTRONIC ACCESS AND DOOR CONTROL (EADR – VA Identified as a Patient/Staff/Public Safety System)

- (a) Provide EADR_system(s) as required. Refer to VA Master Specification 28 13 16.
- (b) Contact TVE-005OP3B for specific engineering design and technical approvals when a EADR System is required for the facility.

7.7.9 RADIO PAGING SYSTEM (RPS – VA identified as a Public Safety and Emergency Communications System, and the redundant Code One/Blue Team notification system)

- (a) Provide RPS (identified as Public Safety Operation and upgraded to Life Safety when interfaced to Code One (Blue) as required. Refer to VA Master Specifications.
- (b) Contact TVE-005OP3B for specific engineering design and technical approvals when a RPS System is required for the facility.

7.7.10 PATIENT/STAFF ANNUNCIATOR/LOCATOR SYSTEM (PAL – VA identified as a Patient/Staff Safety Communications System)

- (a) Provide PAL system(s) as required. Refer to VA Master Specification 28 13 11.
- (b) Contact TVE-005OP3B for specific engineering design and technical approvals when a PAL System is required for the facility.

7.7.11 TWO-WAY RADIO SYSTEM (TRS – VA identified as an Emergency Communications System)

- (a) Provide TRS system(s) as required. Refer to VA Master Specification 27 32 41.
- (b) Contact TVE-005OP3B for specific engineering design and technical approvals when a TRS System is required for the facility.

7.7.12 EMERGENCY NOTIFICATION SYSTEM (aka DURESS ALARM (ENS – VA identified as an Patient/Staff Safety Communications System)

- (a) Provide ENS system(s) as required. Refer to VA Master Specification 28 26 00.
- (b) Under no circumstance shall the telephone system be used to provide duress alarm functions, although telephone STP or UTP circuits may be used with TVE-005OP3B approval as long as there are enough spare pairs to satisfy the telephone system installation and projected growth, and each system does not interfere with the other.
- (b) Contact TVE-005OP3B for specific engineering design and technical approvals when a ENS System is required for the facility.

7.7.13 SECURITY MANAGEMENT AND CONTROL, AND CENTRALIZED POLICE SECURITY MANAGEMENT SYSTEMS (SMS – VA identified as a Patient/Staff/Physical Security Communications System)

- (a) Provide SMS system(s) and/or centralized police security management systems as required. Refer to VA Master Specification 28 13 16.
- (b) Contact TVE-005OP3B for specific engineering design and technical approvals when a SMS System is required for the facility.

7.7.14 PATIENT ANNUNCIATOR/LOCATOR SYSTEM (PAS - VA identified as a Patient/Staff/Physical Security Communication System)

CHAPTER 7: TELECOMMUNICATIONS CABLE PATHWAYS, WIRING AND CABLES, AND
INFRASTRUCTURE PLANT; AND SPECIAL TELECOMMUNICATIONS SYSTEMS

- (a)** Provide PAS system(s) as required. Refer to VA Master Specification 28 16 11.
- (b)** Contact TVE-005OP3B for specific engineering design and technical approvals when a PAS is required for the facility.

CHAPTER 8: TELECOMMUNICATIONS/SPECIAL SYSTEMS ROOMS AND SPACE
REQUIREMENTS

CHAPTER 8: TELECOMMUNICATIONS/SPECIAL SYSTEMS ROOMS AND SPACE
REQUIREMENTS

8.1	SCOPE	8-5
8.2	ROOM TYPES AND DEFINITIONS	8-5
8.2.1	GENERAL	8-5
8.2.2	HEADEND EQUIPMENT (HE) ROOM	8-5
8.2.3	ENTRANCE ROOM (ER OR DMARC).....	8-5
8.2.4	TELEPHONE EQUIPMENT ROOM (TER).....	8-5
8.2.5	TELEPHONE CONSOLE ROOM (TCR)	8-6
8.2.6	MAIN COMPUTER ROOM (MCR)	8-6
8.2.7	TELECOMMUNICATIONS ROOM (TR).....	8-6
8.2.8	POLICE, EMERGENCY, AND DESIGNATED CONTROL ROOMS	8-6
8.3	GENERAL ENVIRONMENTAL, POWER AND SPACE REQUIREMENTS	8-6
8.3.1	GENERAL	8-6
8.3.2	LOCATION, PROTECTION, AND ACCESS	8-6
8.3.3	ROOM ENVELOPE	8-7
8.3.4	HEATING, VENTILATION, AND AIR CONDITIONING	8-7
8.3.5	POWER	8-7
8.3.6	LIGHTING	8-8
8.3.7	GROUNDING	8-8
8.3.8	SECURITY	8-8
8.3.9	CABLE AND WIRE PATHWAYS.....	8-8
8.4	HEADEND EQUIPMENT (HE) ROOM	8-9
8.4.1	GENERAL	8-9
8.4.2	LOCATION	8-9
8.4.3	CONFIGURATION	8-9
8.4.4	ROOM ENVELOPE	8-10
8.4.5	TIP WIRE/CABLE INTERFACE AREA.....	8-10
8.4.6	HEATING, VENTILATION, AND AIR CONDITIONING	8-10
8.4.7	FIRE PROTECTION.....	8-10
8.4.8	POWER.....	8-11
8.4.9	LIGHTING	8-11
8.4.10	GROUNDING	8-11
8.4.11	SECURITY	8-11
8.4.12	WIRE MANAGEMENT	8-11
8.5	ENTRANCE ROOM (ER OR DMARC).....	8-12
8.5.1	LOCATION	8-12
8.5.2	CONFIGURATION	8-12
8.5.3	FIRE PROTECTION.....	8-12
8.5.4	SECURITY.....	8-12
8.5.5	OTHER REQUIREMENTS.....	8-12
8.6	TELEPHONE EQUIPMENT ROOM (TER).....	8-12
8.6.1	LOCATION	8-12
8.6.2	CONFIGURATION	8-13
8.6.3	ROOM ENVELOPE	8-13
8.6.4	TIP WIRE/CABLE INTERFACE AREA.....	8-14
8.6.5	HEATING, VENTILATION, AND AIR CONDITIONING	8-14
8.6.6	FIRE PROTECTION.....	8-14

CHAPTER 8: TELECOMMUNICATIONS/SPECIAL SYSTEMS ROOMS AND SPACE REQUIREMENTS

8.6.7	POWER	8-14
8.6.8	LIGHTING	8-15
8.6.9	GROUNDING	8-15
8.6.9.1	Telecommunications Main Ground Bar	8-15
8.6.10	SECURITY	8-15
8.7	TELEPHONE CONSOLE ROOM	8-15
8.7.1	CONFIGURATION/CONSOLES	8-16
8.7.2	HEATING, VENTILATION AND AIR CONDITIONING	8-16
8.7.3	FIRE PROTECTION	8-16
8.7.4	POWER	8-16
8.7.5	LIGHTING	8-16
8.7.6	ALARM PANELS	8-16
8.8	MAIN COMPUTER ROOM (MCR)	8-16
8.8.1	RELIABILITY	8-16
8.8.2	LOCATION	8-17
8.8.3	CONFIGURATION	8-17
8.8.3.1	Area	8-17
8.8.3.2	Walls	8-18
8.8.3.3	Access Floor (Optional)	8-18
8.8.3.4	Doors	8-19
8.8.3.5	Ceiling	8-19
8.8.4	ROOM ENVELOPE	8-20
8.8.5	HEATING VENTILATION, AND AIR CONDITIONING	8-20
8.8.6	FIRE PROTECTION	8-20
8.8.7	POWER	8-20
8.8.8	LIGHTING	8-21
8.8.9	GROUNDING	8-21
8.8.10	SECURITY	8-21
8.8.11	WIRE MANAGEMENT	8-22
8.9	TELECOMMUNICATIONS ROOM (TR)	8-22
8.9.1	CONFIGURATION	8-22
8.9.2	ROOM ENVELOPE	8-22
8.9.3	HEATING, VENTILATION, AND AIR CONDITIONING	8-23
8.9.4	FIRE PROTECTION	8-23
8.9.5	POWER	8-23
8.9.6	LIGHTING	8-23
8.9.7	GROUNDING	8-23
8.9.8	SECURITY	8-23
8.9.9	WIRE MANAGEMENT	8-23
8.10	REMOTE OR SECONDARY TELECOMMUNICATIONS ROOM	8-23
8.10.1	LOCATION	8-23
8.10.2	CONFIGURATION	8-24
8.10.3	ROOM ENVELOPE	8-24
8.10.4	HEATING, VENTILATION, AND AIR CONDITIONING	8-24
8.10.5	FIRE PROTECTION	8-24
8.10.6	POWER	8-24
8.10.7	LIGHTING	8-24

CHAPTER 8: TELECOMMUNICATIONS/SPECIAL SYSTEMS ROOMS AND SPACE
REQUIREMENTS

8.10.8 GROUNDING 8-24

8.10.9 SECURITY 8-24

8.10.10 WIRE MANAGEMENT 8-24

8.11 TERMINAL CABINETS 8-24

8.12 POLICE, ENGINEERING AND OTHER DESIGNATED CONTROL
ROOM(S) 8-25

This page intentionally left blank.

CHAPTER 8: TELECOMMUNICATIONS/SPECIAL SYSTEMS ROOMS AND SPACE REQUIREMENTS

8.1 SCOPE

- (a) This chapter covers the requirements for telecommunications, data, and special systems rooms and spaces to be provided in VA facilities.
- (b) Contact VA Telecommunications Voice Engineering Division (TVE-005OP3B) at 301-734-0350 for assistance with systems design and preparation of construction documents.

8.2 ROOM TYPES AND DEFINITIONS

8.2.1 GENERAL

Provide rooms as determined by project requirements. Not all room types may be required and not all required room types may be listed below.

8.2.2 HEADEND EQUIPMENT ROOM (OPTIONAL)

A/E NOTE - THE NEED FOR HEAD END ROOM WILL BE DETERMINED BY THE PROJECT REQUIREMENTS. IF A HEAD END ROOM IS NOT PROVIDED THEN FUNCTIONS AND REQUIREMENTS WILL BE INCLUDED IN A SEPARATE ROOM FROM THE TER AND MCR TO INSURE INTERFERENCE IS NOT DETECTED IN THESE AREAS.

The HE Equipment Room (optional) will be located in the mechanical penthouse or other area dictated by system design. The room will accommodate all provided and planned Special Systems and Head-end Cabinets (i.e. MATV, CCTV, SSTV, RED, PA, Two-Way Radio, RPS, etc.). See Chapter 7 for Special Systems information. The room will be sized for a minimum of (5) each separate systems.

8.2.3 ENTRANCE ROOM (ER - or DMARC)

The ER is a room or rooms designed to be the initial termination point for services being brought to the building by outside providers, such as telephone companies, data providers, CATV providers, security providers, etc.

8.2.4 TELEPHONE EQUIPMENT ROOM (TER)

THE TER WILL BE DESIGNED TO HOUSE EQUIPMENT TO PROVIDE TELEPHONE (AKA VOICE) SERVICES TO THE ENTIRE BUILDING OR FACILITY. IN ADDITION TO THE TER, THERE MAY BE A TCR TO AUGMENT THE OPERATION AND FUNCTION OF THE TELEPHONE EQUIPMENT LOCATED IN THE TER.

8.2.5 TELEPHONE CONSOLE ROOM (TCR) (OPTIONAL)

The TCR is where telephone operators are located. Operators provide service to the entire building or facility. The Telephone Console Room is in many cases, but not all, continuously staffed. At many facilities the operators also have the responsibility of monitoring critical alarms for equipment throughout the facility.

8.2.6 MAIN COMPUTER ROOM (MCR)

The MCR will be designed to house equipment to provide data and telephone services to the entire building or facility. In addition to the MCR, there may be a Standby Computer Room (SCR) that will provide backup services in the event of a catastrophic failure at the MCR.

8.2.7 TELECOMMUNICATIONS ROOM (TR)

- (a) The TR is a room designed to centrally deliver telephone, data, and special systems services to users and equipment on that floor. There may be multiple rooms on a floor. Where multiple rooms are employed, the TRs shall be associated with specific functional areas, as well as being stacked from floor to floor.
- (b) The design "TR" replaces the terms "Signal Closet" and "Telecommunications Closet," which are no longer used. The new designation indicates the current construction practice of combining telephone, data, special systems and fire alarm functions into one terminus, control and distribution point. If security requirements require separation of systems, this will be accomplished by a chain link or other barrier that will provide physical security while allowing common lighting, heating and cooling, and power systems.

8.2.8 POLICE, ENGINEERING AND EMERGENCY DESIGNATED CONTROL ROOMS

Police Control Room (PCR), Engineering Control Room (ECR), and other designated control rooms are other rooms throughout the facility that house specialized functions

8.3 GENERAL ENVIRONMENTAL, POWER AND SPACE REQUIREMENTS

8.3.1 GENERAL

The following is a list of minimal environmental, power, and space requirements that apply to all telephone, data, and special system rooms and spaces (hereinafter referred to as 'rooms' in this article) that contain electronic and physical telecommunications equipment. The list is not all inclusive and additional information or requirements may be found in this chapter.

8.3.2 LOCATION, PROTECTION, AND ACCESS

- (a) Rooms shall be rectangular in shape and free of obstructions, such as columns and braces, if possible. If columns or braces are present, they shall not impede the installation or operation of individual system equipment and access to each equipment cabinet's front, side or rear. The floor area occupied by the column shall not be counted as a part of the room's minimum useable area requirements.

CHAPTER 8: TELECOMMUNICATIONS/SPECIAL SYSTEMS ROOMS AND SPACE REQUIREMENTS

- (b) Rooms shall be located above the Base Flood Elevation. Rooms shall not be located beneath toilets, showers, laboratories, kitchens, sinks, open courtyards, planters, roof drain leaders, or other areas where water service is provided. Active telephone, data, and special systems equipment is not allowed to be installed in elevator penthouses or mechanical rooms; dedicated rooms are required.
- (c) Rooms shall be designed to allow maintenance equipment access, and to facilitate equipment replacement without significant demolition and reconstruction.
- (d) Rooms shall not be located in patient care areas.
- (e) Any pipe or duct system foreign to the telecommunications installation shall not enter or pass through a room. The A/E shall ensure that foreign piping such as water pipes, steam pipes, medical gas pipes, sanitary waste pipes, roof drains, A/C ducts and other unrelated piping systems containing liquids or gases are not installed or pass through rooms. Sprinkler piping shall not be routed through telecommunications spaces, unless it serves to protect the telecommunications installation.
- (f) Rooms shall be located away from or protected from sources of EMI at a distance which will reduce the interference to less than 3.0V/m through the frequency spectrum. Pay special attention to EMI from electrical power supplies, transformers, motors, generators, X-ray equipment, radio transmitters and induction heating devices.
- (g) Rooms shall be located to minimize effects of lightning strikes and sunlight radiant heating.

8.3.3 ROOM ENVELOPE

- (a) All rooms shall have finished flooring of material with static control (electrostatic discharge (ESD)) properties.
- (b) If access floor is required, consider a depressed slab to eliminate wasted space from ramps, entryways, and steps. Access floor loading capacity shall be sufficient to bear both the distributed and concentrated load of the provided and planned equipment.
- (c) Floors, walls and ceilings shall be sealed to prevent dust. Walls shall be painted in a light color.
- (d) Backboards shall be ¾" fire-retardant treated plywood.

8.3.4 HEATING, VENTILATION, AND AIR CONDITIONING

Refer to the HVAC Design Manual.

8.3.5 POWER

Power for all rooms is required for 24x7x365 operations. Equipment shall be connected to the appropriate branch of the Essential Electrical System. Equipment (other than HVAC) shall be backed by an uninterruptible power supply (UPS).

8.3.6 LIGHTING

Refer to Chapter 6 and Appendix A – Illumination Levels for room lighting requirements.

8.3.7 GROUNDING

- (a) Telecommunications systems grounding and bonding will consist, at a minimum, of an equipotential grounding system (Telecommunications Bonding Backbone (TBB)) that originates from the Telecommunications Main Ground Bar (TMGB). The TMGB (typically located in the Telephone Equipment Room) is then connected to other telecommunications spaces, independently from other building grounding systems such as electrical or lightning protection, via the TBB. The TMGB is connected to the building electrical service ground point via a mechanically and electrically protected minimum #1/0 copper equipotential grounding conductor, and to building steel. The TBB helps ensure that all equipment in the telecommunications spaces is referenced at the same equipotential earth ground level, and reduces high frequency electrical noise resulting from high speed digital switching, RFI and EMI. Cabinet, rack and fixed structures bonding conductor(s) shall be minimum #6 AWG insulated stranded copper wire, or equal copper braid. All frames and cabinets shall be grounded in accordance with ANSI/TIA/EIA-607.
- (b) The telecommunications grounding system will comply with ANSI/TIA/EIA-607 requirements and follow BICSI - Telecommunications Distribution Methods Manual (Latest Edition) guidelines.

8.3.8 SECURITY

- (a) The minimum physical security requirements for the DEMARC, TER, MCR, TR, and additional Telecommunications Rooms is an electronic security system that is connected to and fully functional with the PCR SMS and a cipher lock with numeric keypad, associated electronic card access device and electric strike and digital CCTV camera for personal remoted to the Chief's Office and directly controlled by the facility's SMS. Each room security system shall be powered from the building essential electrical with local UPS system backup.
- (b) Each programmable door control shall be fully functional with the SMS in a stand-alone status if its connection to the controller is cut (aka 'smart system'). Once the connection is restored, the local door control system shall update the SMS on all operations that occurred after the connection was interrupted, and the SMS shall update the local door control units to current operational function.
- (c) The Access Control and SMS shall be fully compliant with VA PIV 'Smart' ID Card and at a minimum FIPS 201-1 listed and labeled.

8.3.9 CABLE AND WIRE PATHWAYS

Refer to Chapter 7 for conduit and pathway requirements.

8.4 HEADEND EQUIPMENT (HE) ROOM (OPTIONAL)

8.4.1 GENERAL

A/E NOTE - THE NEED FOR HEAD END ROOM WILL BE DETERMINED BY THE PROJECT REQUIREMENTS. IF A HEAD END ROOM IS NOT PROVIDED, THEN FUNCTIONS AND REQUIREMENTS WILL BE INCLUDED IN A SEPARATE ROOM FROM THE TER AND MCR TO ENSURE INTERFERENCE IS NOT DETECTED IN THESE AREAS.

The HE Equipment Room will be located in the general mechanical penthouse or other area dictated by system design. The room will accommodate all provided and planned Special Systems, Head-end Cabinets (i.e. MATV, CCTV, SSTV, RED, Satellite TV, PA, Two-Way Radio, Radio Paging and M/W Radio, etc.) See Chapter 7 for Special System descriptions and information. The room will be sized for a minimum of (5) each separate systems.

8.4.2 LOCATION

- (a)** A dedicated room is required. This room shall be located in the mechanical penthouse (as close as possible to a roof entrance) or attic, or an area as dictated by system design. It shall not be located in the elevator equipment room, or in the basement, or below the Base Flood Elevation.
- (b)** The HE Room shall not be located further than 300 ft. [90m] from the nearest vertically stacked TR.
- (c)** If located in the mechanical penthouse or attic and approved by TVE-005OP3B, the room may be separated from the rest of the area by floor-to-ceiling metal chain-link security fence with a minimum 40 in. by 84 in. [1.0m by 2.1m] locking gate with two sets of keys. If located in the HE Room, telephone or data equipment shall not use fencing of any type except to partition area within the secure HE Room.

8.4.3 CONFIGURATION

- (a)** The HE Room shall be a minimum of 10 ft. x 12 ft. [3m x 3.7m], or as large as the sum of the provided and future systems require, including space for UPS equipment. The HE Room shall be sized for the headend equipment of a minimum of five (5) each separate systems, four (4) each future systems, one (1) each overhead and wall wire management system, four (4) each 4" ID weatherproof wall/ceiling cable feedthrus, and two (2) each 4" ID conduits to the nearest vertically stacked telecommunications room. The space for future systems shall be clearly indicated on the contract documents. Space shall be per Table 8-1:

Table 8-1 Headend Equipment Room Size

NUMBER OF EQUIPMENT CABINET/RACKS	ROOM SIZE SQ FT [SQ M]
4 minimum	224 [22]
Add 2 UPS	224 [22]
Add 1 for System Grounding Block/Main TIP Distribution Panel (MTDP)	256 [24]
5 minimum	256 [24]
Add 2 for UPS	256 [24]
Add 1 for System Grounding Block/MTDP	289 [27]

- (b) Cabinets are installed joined or side by side, in which case where the 3 ft. [900mm] rule applies around the entire assembly. Minimum ceiling height shall be 8 ft. [2.4m] above finished floor.
- (c) The HE Room may be sized to use an Environmental Equipment Protection Cabinet in lieu of an air-handled space, if previously approved by the Facility Engineer and TVE-005OP3B. Add three (3) each sf with 3 ft. [900mm] clear floor area circumference per environmental cabinet.

8.4.4 ROOM ENVELOPE

Room shall be enclosed with fire-rated construction in accordance with NFPA 75.

8.4.5 TIP WIRE/CABLE INTERFACE AREA

Provide a plywood-covered wall area, minimum size of 8 ft. x 8 ft. [2.4m x 2.4m], to provide a common termination point for all the cabling entering and leaving the HE Room.

8.4.6 HEATING, VENTILATION, AND AIR CONDITIONING

- (a) Refer to the HVAC Design Manual.
- (b) A minimum of 30,000 BTU/H cooling capacity is required.
- (c) A fully climate-controlled, stand-alone equipment cabinet is acceptable for each special system in lieu of fully acclimatizing the HE Room.

8.4.7 FIRE PROTECTION

Refer to the VA Fire Protection Design Manual.

8.4.8 POWER

Refer to Article 8.3.5, POWER.

8.4.9 LIGHTING

Refer to Article 8.3.6, LIGHTING.

8.4.10 GROUNDING

- (a) Provide a copper bus plate minimum 6 in. x 18 in. x 0.5 in. [150mm x 450mm x 13mm], with a connection point located on the inside wall within the immediate area of the antenna coaxial cable(s) entrance conduit sleeves. Connect this plate to the lightning protection system with a minimum #1/0 AWG stranded copper wire, or increased sized connection device (i.e. strap, buss, etc.) as approved by the RE, to maintain the integrity of the lightning protection system so each of the system antenna cables' coaxial cable lightning protector can be installed and connected to the plate.
- (b) Refer to Article 8.3.7, GROUNDING for additional requirements.

8.4.11 SECURITY

Refer to Article 8.3.8, SECURITY.

8.4.12 WIRE MANAGEMENT

- (a) The HE Room shall be provided with waterproof wall entrance sleeves (Refer to Table 7.2) to allow connecting of each outside antenna coaxial cable to the HE Room equipment. Add extra like sleeves for additional outside mounted antennas as required by system design. One of these sleeves shall contain only the lightning protection connection.
- (b) The HE Room shall be provided with a minimum separate 6 in. x 6 in. [150mm x 150mm] cable duct/ladder/wireway from the designated TIP interface point to the dedicated waterproof locking 24" x 24" x 12" [600mm x 600mm x 300mm] TIP connection enclosure. A minimum 12" [300mm] cable ladder may be used for this purpose if previously approved by TVE-005OP3B. A minimum of five (5) each 3" [75mm] conduits may be provided in lieu the cable duct/ladder/wireway; additional cable duct/ladder/wireway shall be provided based on overall system design, as coordinated with TVE-005OP3B.
- (c) The mixing of coaxial cables and STP/UTP/fiber optic/AC and DC power wiring within the cable duct/ladder/wireway and/or conduits is not allowed.
- (d) Each wire/cable connection point shall be provided with a connection MDF capability and routes to connect the room's internal wire management system to the facility's TIP system.

8.5 ENTRANCE ROOM (ER OR DMARC)

A/E NOTE: THE ENTRANCE ROOM IS NOT OPTIONAL. ITS FUNCTIONS WILL BE IN A STAND ALONE MODEL PER THE PHYSICAL SECURITY DESIGN MANUAL. IF THIS CONFIGURATION IS NOT RELATIVE TO THIS FACILITY, THE ER FUNCTION AND LOCATION SHALL BE PROVIDED ADJACENT TO THE TER.

8.5.1 LOCATION

Refer to Article 8.3.2 LOCATION, PROTECTION, AND ACCESS.

8.5.2 CONFIGURATION

The Entrance Room shall be a minimum of 12 ft. x 8 ft. x 8 ft. [3.7m x 2.4m x 2.4m], and shall be equipped with backboards as required by system design.

8.5.3 FIRE PROTECTION

No additional criteria.

8.5.4 SECURITY

Refer to Article 8.3.8, SECURITY.

8.5.5 OTHER REQUIREMENTS

All other requirements of Article 8.3, GENERAL ENVIRONMENTAL, POWER AND SPACE REQUIREMENTS, apply to the Entrance Room.

8.6 TELEPHONE EQUIPMENT ROOM (TER – VA identified as Critical Service and elevates to Life Support when Code One / Blue Functions are provided in the equipment control)

8.6.1 LOCATION

- (a)** The TER shall be located within a cable distance of 100 ft. [30m] of the Console or Operator Room. It should be located close to the DEMARC and MCR rooms, away from exterior windows, and if possible, as close as possible to an outside telephone company cable Entrance Room.
- (b)** A floor drain, evacuating and/or sump water pump, etc. shall be provided within the room if risk of water ingress exists. A high water level alarm annunciating system shall be provided in addition to intrusion alarm(s) that connects to the facility's ECR, PCR, SMS Console, and one other continuously-manned location (i.e. Telephone Operator or MAS Emergency Room Desk, etc.).

8.6.2 CONFIGURATION

- (a) Space shall be per Table 8-2:

Table 8-2 Minimum Telephone Equipment Room Size

NUMBER OF LINES	ROOM SIZE SQ FT [SQ M]
600 to 900	500 [47]
901 to 1,600	700 [65]
1,601 to 2,000	900 [84]
2,001 to 2,400	1,100 [102]
2,401 to 2,800	1,300 [121]
2,801 to 3,200	1,500 [140]
3,201 to 4,000	1,700 [158]

- (b) A minimum of 3 ft. [910mm] shall be provided around each cabinet unless the cabinets are installed joined or side by side where the 3 ft. [910mm] rule applies around the entire assembly. Minimum suspended ceiling height shall be 8 ft. [2.4m] above finish floor. The TER shall be a minimum of 12 ft. x 14 ft. [3.7m x 4.3m] or as large as the sum of the planned systems, two spare systems, and access requirements.
- (c) If the TER is to be provided with an access floor (i.e. cellular flooring or computer flooring - refer to Article 8.8.3.3 for specific floor guidelines), it shall be provided with a minimum 20 in. [500mm] finished floor height, approximately 100 sq. ft. to 150 sq. ft. [9.3 sq. m to 14 sq. m] and a suspended ceiling. The portion of the Telephone Equipment Room used for batteries, rectifiers and inverters shall not have access flooring.
- (d) The TER shall be equipped with a 40 in. x 84 in. [1.0m x 2.1m] high self-closing and locking metal insulated door equipped with a deadbolt key lock and/or electronic lock. Also, each door shall be provided with an intrusion alarm to be annunciated locally, at the Facility's Engineering Control Room, Security Police Control Console and one other continuously-manned location (i.e. Telephone Operator or MAS Emergency Room Desk).
- (e) Sufficient backboards shall be provided to limit interconnection wire and cable length from backboard to the room wire management system and planned cabinets. Backboards shall be located so as to allow unobstructed access to entrance and exit cable ducts, internal room wire management system, cabinets and doors.
- (f) Sufficient space should be provided for UPS equipment and fire suppression system bottles.

8.6.3 ROOM ENVELOPE

Room shall be enclosed with fire-rated construction in accordance with NFPA 75.

8.6.4 TIP WIRE/CABLE INTERFACE AREA

- (a) Within the TER there will be an area designated that houses and locates all TIP conduit and cable pathway terminations coming into the room from TRs, HE room, MCR, and either the single or duplicated Entrance Rooms (DEMARC).
- (b) This area shall be a minimum of 12 ft. x 8 ft. x 8ft. [3.7m x 2.4m x 2.4m] in addition to the minimum area required by the Telephone Equipment Room.
- (c) This area will house the distribution cable management system.

8.6.5 HEATING, VENTILATION, AND AIR CONDITIONING

- (a) Refer to the HVAC Design Manual.
- (b) HVAC load calculations shall include the rectifiers and associated batteries. Cooling requirements shall be based on system design with 30% reserve capacity. Cooling equipment shall be dedicated to the room, and an N+1 configuration shall be provided for reliability.

8.6.6 FIRE PROTECTION

Refer to the VA Fire Protection Design Manual.

8.6.7 POWER

- (a) Refer to Article 8.3.5, POWER.
- (b) UPS system must provide power for a period of 4 hours, or as required in the Physical Security Design Manual. Power shall be distributed by Power Distribution Units (PDUs).
- (c) UPS equipment shall be sized based on the equipment requirements, plus future anticipated growth. The initial design load shall not be less than 30% and not more than 70% of the UPS capacity.
- (d) The UPS shall be monitored by the PCR SMS for power, alarms, and alarm history. The UPS shall have dry contacts or external alarm and control from the PCR SMS and one "C" contact for local computer signaling. The UPS shall be provided with computer system shutdown software and hardware connectivity as required.
- (e) The sharing of the TER's UPS is NOT allowed unless specifically approved by TVE 005OP3B during the project's technical approval of contract drawings and specifications.
- (f) The room shall be equipped with dedicated electrical panel(s) capable of providing 208/120V, 3-phase, 4-wire and designed for the equipment load. Each panel shall contain 20% spare electrical capacity and spare circuit breaker space.

- (g) Provide a minimum of one quadruplex receptacle (two duplex) for each 8 linear ft. [2.4m] of wall space.
- (h) Emergency Power Off (EPO) push buttons shall be installed according to NFPA 75.

8.6.8 LIGHTING

- (a) Refer to Article 8.3.6, LIGHTING.
- (b) Provide battery-powered lighting in accordance with NFPA 75 and 101.

8.6.9 GROUNDING

8.6.9.1 Telecommunications Main Ground Bar

- (a) Refer to Article 8.3.7, GROUNDING.
- (b) The Telephone Equipment Room shall be provided with a building earth ground connection by a clearly marked copper equipotential bus bar (Telecommunications Main Ground Bar (TMGB)).
- (c) The TMGB shall be directly connected to the facility's electrical ground via a mechanically and electrically protected minimum #1/0 AWG stranded copper equipotential grounding conductor. An AC electrical equipment grounding conductor is not acceptable for this function and will not be approved.

8.6.10 SECURITY

- (a) Refer to Article 8.3.8, SECURITY.
- (b) Each door shall have a color security surveillance camera that connects to a color monitor in the IT Chief's Office and that is routed to the PCR.
- (c) A MID system shall be installed within the TER. The system shall be controlled and monitored by the PCR SMS.
- (d) An emergency voice operated sound system shall be installed within the TER that is terminated in the PCR SMS and the IT Chief's Office.
- (e) A duress alarm button shall be placed every 10 linear ft. [3m] within the TER, annunciating to the PCR SMS and ECR, in addition to the Telephone Console Room and one additional continuously-manned location.

8.7 TELEPHONE CONSOLE ROOM (Optional)

A/E NOTE - THE NEED FOR TELEPHONE CONSOLE ROOM WILL BE DETERMINED BY PROJECT REQUIREMENTS.

8.7.1 CONFIGURATION/CONSOLES

- (a) Space shall be per Table 8-3:

Table 8-3 Telephone Console Room Size Requirements

NUMBER OF CONSOLES	SPACE REQUIRED SQ FT [SQ M]
1	100 [9]
2	150 [14]

- (b) Provide a restroom and break room, separate for the Operations Area.

8.7.2 HEATING, VENTILATION, AND AIR CONDITIONING

Refer to the HVAC Design Manual.

8.7.3 FIRE PROTECTION

No additional criteria.

8.7.4 POWER

- (a) Refer to Article 8.3.5, POWER.
- (b) Provide sufficient 120V receptacles at each operator position.

8.7.5 LIGHTING

Refer to Article 8.3.6, LIGHTING.

8.7.6 ALARM PANELS

Provide adequate space, heating and cooling, power, lighting, and telecommunications raceways for alarm panels as required for each project. As a minimum, provide for nurse call Code One (Blue), public address, emergency notification, duress alarm, fire alarm, and emergency and standby generator alarm annunciator panels.

8.8 MAIN COMPUTER ROOM (MCR)

8.8.1 RELIABILITY

- (a) The Uptime Institute has developed a system for classifying the expected reliability of data centers and computer rooms based on how the rooms were constructed, types of equipment used, and how services were delivered. Four Tier levels were designated, and high level characteristics along with expected reliability for each Tier are listed below:

Tier I – Tier I is composed of a single path for power and cooling distribution, without redundant components, providing 99.671% availability.

CHAPTER 8: TELECOMMUNICATIONS/SPECIAL SYSTEMS ROOMS AND SPACE REQUIREMENTS

Tier II – Tier II is composed of a single path for power and cooling distribution, with redundant components, providing 99.741% availability.

Tier III – Tier III is composed of multiple active power and cooling distribution paths, but only one path active, has redundant components, and is concurrently maintainable, providing 99.982% availability

Tier IV – Tier IV is composed of multiple active power and cooling distribution paths, has redundant components, and is fault tolerant, providing 99.995% availability.

- (b) The A/E should be familiar with the concepts involved and incorporate as many of the specific Tier III requirements into their design as practical.
- (c) NOTE: When a telecommunications system is intended to be connected to VA's LAN/WAN that contains a Nationally Coded functional rating (i.e., Telephone Systems are Nationally Rated as "Critical Service" and are upgraded to "Life Support" when the Telephone System is controlling the Facility's Code Blue Function; Nurse Call Systems are ranked as "Emergency" and Code Blue is ranked as "Life Safety/Support;" Police Radio System are ranked "Emergency;" PA Systems are ranked as "Public Safety" and raised to "Life Safety/Support" when carrying Code Blue Signals, etc.) then the LAN/WAN's functional rating must be upgraded to be Nationally Rated as the connecting system. If the LAN/WAN is not able to function in the enhanced ranking environment, the intruding system MUST NOT be connected to the LAN/WAN until it can be determined to meet the appropriate National Code Ranking.

8.8.2 LOCATION

- (a) Refer to Article 8.3.2 LOCATION, PROTECTION, AND ACCESS.
- (b) The MCR should be located close to the ER and TER rooms.
- (c) A floor drain, evacuating and/or sump water pump, etc. shall be provided within the room if risk of water ingress exists. A high water level alarm annunciating system shall be provided in addition to intrusion alarm(s) that connects to the PCR, SMS Console, and one other continuously-manned location (i.e. Telephone Operator or MAS Emergency Room Desk).

8.8.3 CONFIGURATION

8.8.3.1 Area

- (a) The MCR useable floor area square footage (sf.) requirements shall be minimum 1,200 sf. (30 ft. X 40 ft.) and shall be increased on a case-by-case basis in minimum of 150 sf. (10 ft. X 15 ft.) increments for:
- Each additional 8,500 sf of facility floor space above the initial facility designed floor space
 - Unique equipment foot print(s), configuration of new systems, ramps, doors and aisle ways, maintenance access to equipment, ceiling and floor furnishings
 - UPS equipment and batteries, fire suppression system bottles, power distribution units (PDUs), etc.
 - Main and Intermediate telecommunication interface/distribution room(s) and corridors.

CHAPTER 8: TELECOMMUNICATIONS/SPECIAL SYSTEMS ROOMS AND SPACE
REQUIREMENTS

- (b) Provide office(s) required for MCR function and operation (i.e. Chief's, data storage, maintenance/service, etc.).
- (c) Provide one (1) each additional space to encompass projected expansion, to be included separately after each of the aforementioned added space requirements have been incorporated into the MCR design.
- (d) A minimum of 3 ft. [910mm] shall be provided in front and back of each rack or cabinet. Minimum suspended ceiling height shall be 9 ft. [2.7m] above finish floor. The MCR shall be a minimum of 10 ft. x 12 ft. [3m x 3.7m] or as large as the sum of the planned systems, two spare systems, and access requirements.
- (e) Sufficient backboards shall be provided to limit interconnection wire and cable length from backboard to the room wire management system and planned cabinets. Backboards shall be located so as to allow unobstructed access to entrance and exit cable ducts, internal room wire management system, cabinets and doors.

8.8.3.2 Walls

Walls shall be reinforced on jamb side of Ballistic Resistant doors to BR Level 3, UL 752 to within 48 in. [1.2m] of each jamb from structural floor to MCR ceiling height.

A/E NOTE: THE NEED FOR ACCESS FLOOR WILL BE DETERMINED BY PROJECT REQUIREMENTS.

8.8.3.3 Access Floor (Optional)

- (a) An access floor of "bolted stringer design" shall be installed in the MCR and each subordinate computer room to accommodate power, data and telecommunications cabling, and other authorized utilities.
- (b) The access floor shall have a minimum 500mm (20 in.) clearance between the structural floor to the bottom of the access floor. The access floor shall meet the minimum performance specifications in Table 8-4:

Table 8-4 MCR Floor Requirements

FUNCTION	POUNDS-FORCE (LBF) POUNDS PER SQUARE FEET (PSF)
Uniform load	250 Lbs psf
Concentrated	1,000 lbf
Overturning moment	1,000 lbf x inches
Axial load	5,000 lbf
Impact load	100 lbf

- (c) The floor panels shall consist of a high-density particleboard wood core for sound absorption, and a high pressure laminate surface with integral, perimeter edging. The floor panel size shall be a minimum of 24 in. [600mm] square. An additional 20% of each variety and color, including cutout and perforated vent panels shall be provided as spares. One factory perforated or cutout panel shall be provided for each ton of air conditioning. Cutout edges shall be provided with self-extinguishing foam rubber seals.
- (d) If the access floor cannot be installed flush with adjoining finish floors, provide a minimum of one main pedestrian entry ramp from a corridor. The ramp shall be a minimum of 6 ft. [1.8m] wide and have double door access of the same width and minimum 7 ft. [2.1m] high. The ramp shall have a maximum slope of 1:12, and a minimum 7 ft. x 6 ft. [2.1m x 1.8m] clear landing at the bottom. The doors shall be out-swing and incorporate a hold-open feature to facilitate equipment and cart access. The ramp shall be covered with a non-skid surface of rubber flooring with a raised circular disc pattern (or equal), and shall have a minimum 800 lbf [3559N] rolling load capacity.
- (e) The access floor shall be used as a cooling air plenum for air conditioning units. The supporting structure and "stringers" shall be connected to signal ground system with a minimum #2 AWG stranded copper wire.
- (f) Water and smoke detection devices are required beneath the access floor.
- (g) Prior to the installation of the access floor, the Contractor shall thoroughly clean and seal the structural floor with a cleaner and sealant.

8.8.3.4 Doors

- (a) The MCR shall have a minimum of two outward-swinging doors, 48 in. x 84 in. [1.2 m x 2.1m] high, on each end of the MCR. One door shall exit directly into a corridor.
- (b) Doors, hardware, and frames shall be in labeled accordance with NFPA 80 requirements for the fire resistance rating required. Tamper-proof hinge pins and attaching hardware shall be used.
- (c) Doors shall be Ballistic Resistant BR, Level 3 in accordance with U.L. Standard 752.
- (d) Facility SMS functional control and operation shall be provided on each door.

8.8.3.5 Ceiling

Ceiling height shall be minimum 9 ft. [2.7m] clear above the access floor. The ceiling shall be the suspended acoustical type. The ceiling shall provide a minimum noise reduction coefficient (NRC) of .55. Ceilings shall have a flame spread of less than 25 and a smoke development ratio of 50 or less, according to American Society of Testing and Materials (ASTM) Standard E-84.

8.8.4 ROOM ENVELOPE

Room shall be enclosed with fire-rated construction in accordance with NFPA 75.

8.8.5 HEATING, VENTILATION, AND AIR CONDITIONING

- (a) Refer to the HVAC Design Manual.
- (b) Two identical and independent dedicated MCR air conditioning units are required. Cooling requirements shall be based on system design with 30% reserve and in a N+1 configuration for reliability. The units shall be positioned at opposite ends of the MCR diagonally opposite each other. The units shall have local and PCR SMS monitoring and alarm annunciators. Air filters shall be MCR grade high efficiency. Both units shall operate at all times and share the load, unless one fails or is undergoing maintenance. The units shall be independently supported on OEM supplied stands of the same height as the access floor.
- (c) The air conditioning units shall include refrigerant systems and glycol or DX cooling. Cooling capacity of each unit shall be able to remove all the sensible heat from the MCR. This heat is attributable only to the UPS loads and the heat loss due to the units and the UPS itself (typically 7 – 10%). Heat load from the air conditioning units shall be taken into account. Each unit capacity shall be allowed to remove 110% of the UPS load with both units operating.
- (d) The access floor shall act as the air supply plenum, and shall provide cooling to the equipment and room using cutouts and vent tiles. A minimum of one tile vent per 100 sf is required.
- (e) A fresh air supply from the building's HVAC system shall be provided to the MCR. This shall keep the room at a positive pressure and provide cooling for lighting and personnel load of the room. The minimum building air supply shall be 200 to 300 cubic ft. per minute (CFM).

8.8.6 FIRE PROTECTION

Refer to the VA Fire Protection Design Manual.

8.8.7 POWER

- (a) Refer to Article 8.3.5, POWER.
- (b) The room shall be equipped with dedicated electrical panel(s) capable of providing 208/120V, 3-phase, 4-wire and designed for the equipment load. Each panel shall contain 20% spare electrical capacity and spare circuit breaker space.
- (c) Provide a minimum of one quadraplex receptacle (two duplex) for each 8 linear ft. [2.4 linear m] of wall space.
- (d) An UPS system must provide power for a period of 4 hours, or as required in the Physical Security Design Manual. Power shall be distributed by Power Distribution Units (PDUs).

- (e) UPS equipment shall be sized based on the equipment requirements, plus future anticipated growth. The initial design load shall not be less than 30% and not more than 70% of the UPS capacity.
- (f) The UPS shall be monitored by the PCR SMS for power, alarms, and alarm history. The UPS shall have dry contacts or external alarm and control from the PCR SMS and one "C" contact for local computer signaling. The UPS shall be provided with computer system shutdown software and hardware connectivity as required.
- (g) Each workstation shall be provided with one UPS-backed duplex receptacle and two duplex normal power receptacles for desk lamps, fans, pencil sharpeners, etc.
- (h) Emergency Power Off (EPO) push buttons shall be installed according to NFPA 75.
- (i) The sharing of the MCR's UPS is NOT allowed unless specifically approved by TVE 005OP3B during the project's technical approval of contract drawings and specifications.

8.8.8 LIGHTING

- (a) Refer to Article 8.3.6, LIGHTING.
- (b) Provide battery-powered lighting in accordance with NFPA 75 and 101.

8.8.9 GROUNDING

- (a) Refer to Article 8.3.7, GROUNDING.
- (b) The TMGB shall be directly connected to the facility's electrical ground via a mechanically and electrically protected minimum #1/0 AWG stranded copper equipotential grounding conductor. An AC electrical equipment grounding conductor is not acceptable for this function and will not be approved.

8.8.10 SECURITY

- (a) Refer to Article 8.3.8, SECURITY.
- (b) Each door shall have a color security surveillance camera that connects to a color monitor in the PCR.
- (c) A Motion Intrusion Detection (MID) system shall be installed within the MCR. The system shall be controlled by the PCR SMS.
- (d) A duress alarm button shall be placed every 10 linear ft. [3m] within the MCR, annunciating to the PCR, SMS and ECR, in addition to the Telephone Console Room and one additional continuously-manned location.

8.8.11 WIRE MANAGEMENT

Refer to Article 7.3, CONDUITS AND BOXES. Provide sleeves and conduit for initial and anticipated TIP access to the MCR.

8.9 TELECOMMUNICATIONS ROOM (TR)

- (a) TRs shall be provided in the quantities and locations that will limit telephone/ data/special systems TIP cable/wire runs from the Telecommunications Room to the outlets to a maximum of 300 ft. [90m]. Terminal cabinets shall not be used in lieu of Telecommunications Rooms.
- (b) Rooms may be placed adjacent to electrical rooms when approved by TVE 005OP3B, but shall be provided with shielding to reduce RFI/EMI.

8.9.1 CONFIGURATION

- (a) Refer to Table 8-5. Minimum room size shall be 10 ft. deep by 10 ft. wide [3m x 3m]. Minimum door size shall be 40 in. wide x 84 in. high [1.0m x 2.1m]. For every additional 10,000 sq. ft. [930 sq. m.] of floor space served, there shall be 10 linear ft. [3m] of wall space required. The TR Room will have a minimum of (4) 19 inch racks with vertical wire management. The TR Room shall be sized for the building headend equipment requirements.

Table 8-5 Telecommunications Room Size Requirements

USEABLE FLOOR SPACE* SQ. FT. [M]	ROOM SIZE FT. [M]
5,001-8,000 [465- 743]	10 x 12 [3 x 3.6]
8,001-10,000 [744 – 929]	10 x 14 [3 x 4.2]

- (b) Rooms shall be vertically stacked.
- (c) The back wall of all rooms shall be lined with backboards, 8 ft. high, with the bottom 1 ft. above the finished floor.
- (d) Room height shall be a minimum of 9 ft. above finished floor. Rooms shall not have a suspended ceiling.
- (e) Entrance must have a minimum unobstructed area of 48 in. [1.2m] directly in front of the room door.

8.9.2 ROOM ENVELOPE

Room shall be enclosed with fire-rated construction in accordance with NFPA 75.

8.9.3 HEATING, VENTILATION, AND AIR CONDITIONING

- (a) Refer to the HVAC Design Manual.

- (b) Minimum cooling requirement is 20,000 BT/H. Additional cooling shall be provided according to the actual expected equipment installation and use.

8.9.4 FIRE PROTECTION

No additional criteria.

8.9.5 POWER

- (a) Refer to Article 8.3.5, POWER.
- (b) Provide a separate 120V, dedicated 20A circuit with two (2) quadraplex receptacles centered in each side backboard, two (2) quadraplex receptacles centered in each front backboard either side of the room door, and three (3) quadraplex receptacles centered in the rear backboard. All receptacles shall be 18 in. [450mm] above finished floor. Allow 3 quadraplex receptacles on each 20A circuit.

8.9.6 LIGHTING

Refer to Article 8.3.6, LIGHTING.

8.9.7 GROUNDING

Refer to Article 8.3.7, GROUNDING.

8.9.8 SECURITY

Refer to Article 8.3.8, SECURITY.

8.9.9 WIRE MANAGEMENT

- (a) Each room shall be provided with lateral and vertical risers from the TER and MCR to each room to support a separate TIP distribution system for telephone, data and special systems.
- (b) Refer to Chapter 7 for additional requirements.

8.10 REMOTE OR SECONDARY TELECOMMUNICATIONS ROOM

8.10.1 LOCATION

- (a) Provide these rooms as required by each system design.
- (b) These rooms are typically provided for Special Systems that are allowed in patient or other designated areas that exceed the 300 ft. [90m] maximum wire distance to Telecommunications Rooms, and the installation area is small enough so as to not warrant the larger and more costly stacked Telecommunications Rooms. The use of these rooms must be specifically approved by TVE-005OP3B during the design phase of the project.

8.10.2 CONFIGURATION

- (a) Each room shall be a minimum of 6 ft. x 8 ft. x 8 ft. [1.58m x 2.4m x 2.4m] or according to BICSI Wiring Standards for the areas, whichever is greater. The minimum door size shall be 36 in. wide by 84 in. high [0.9m by 2.1m].
- (b) Each wall shall be provided floor to ceiling with backboards and two (2) 19-inch racks with vertical wire management.

8.10.3 ROOM ENVELOPE

Room shall be enclosed with fire-rated construction in accordance with NFPA 75.

8.10.4 HEATING, VENTILATION, AND AIR CONDITIONING

Refer to the HVAC Design Manual.

8.10.5 FIRE PROTECTION

No additional criteria.

8.10.6 POWER

Refer to Article 8.9.5, POWER.

8.10.7 LIGHTING

Refer to Article 8.9.6, LIGHTING.

8.10.8 GROUNDING

Refer to Article 8.9.7, GROUNDING.

8.10.9 SECURITY

Refer to Article 8.9.8, SECURITY.

8.10.10 WIRE MANAGEMENT

Refer to Article 8.9.9, WIRE MANAGEMENT.

8.11 TERMINAL CABINETS

- (a) May be used where the number of outlets served is minimal, the distance of the run is in excess of 300 ft. [90m] from the otherwise nearest vertically stacked Telecommunications Room, and/or the cost of providing a Telecommunication Room is prohibitive. The use of terminal cabinets as a substitute for Telecommunications Rooms will not be approved.

CHAPTER 8: TELECOMMUNICATIONS/SPECIAL SYSTEMS ROOMS AND SPACE
REQUIREMENTS

- (b) Where required, each cabinet shall be not less than 16 gage steel with doors and concealed hinges attached by welding.
- (c) Doors must be secured by a lock with a minimum of two keys.
- (d) Shall be thoroughly cleaned and painted at the factory with primer and the OEM's standard finish.
- (e) Each cabinet shall have a backboard covering the entire interior surface of the back of each cabinet if equipment-mounting rails are not required.
- (f) Cabinets shall have a minimum inside depth of 16 in. [400mm] from the inside of the door to the face of the backboard.
- (g) For Special Systems, provide equipment-mounting rails, guides and shelves in lieu of the backboard. However, a backboard is acceptable if the cabinet is used solely for the interconnection and distribution of systems wires or cables where active or electronic equipment is not provided.

8.12 POLICE, ENGINEERING AND OTHER DESIGNATED CONTROL ROOM(S)

- (a) Provide minimum one (1) each Police Control Room (PCR) and Engineering Control Room (ECR) and other designated emergency control Space(s) as required by the project for proper security and emergency management.
- (b) These rooms shall comply with Article 8.7, TELEPHONE CONSOLE ROOM.
- (c) Provide these rooms with adequate designated TIP connectivity between the TER and MCR.

This page intentionally left blank.

CHAPTER 9: SPECIAL MEDICAL AND ALARM SYSTEMS

9.1	GENERAL	9-3
9.2	PATIENT WALL SYSTEMS	9-3
9.3	PREFABRICATED BEDSIDE PATIENT UNIT (PBPU).....	9-3
9.3.1	PBPU INSTALLATION	9-3
9.3.2	PBPU APPLICATION	9-4
9.4	MEDICAL GAS, VACUUM AND AIR ALARM SYSTEM.....	9-5

This page intentionally left blank.

9.1 GENERAL

VA uses nonflammable anesthetics in Operating Rooms in Surgical Service and Medical Research Service. Installations in these areas shall conform to the applicable portions of NFPA 99 that pertain to nonflammable anesthetics.

9.2 PATIENT WALL SYSTEMS

In certain intermediate and critical care areas, VA requires the installation of patient wall systems (referred to as Prefabricated Bedside Patient Unit (PBPU)) in patient bedrooms/areas. The PBPUs shall be installed as described herein.

9.3 PREFABRICATED BEDSIDE PATIENT UNIT (PBPU)

- (a)** In certain intermediate and critical care areas, VA requires the installation of Patient Wall System (referred to as Prefabricated Bedside Patient Unit – PBPU) in patient bedrooms/areas. The PBPUs shall be installed as described herein.
- (b)** Each OEM produced-PBPU contains a specific UL Rating, Listing, and Labeling for severe medical applications. UNDER NO CIRCUMSTANCE SHALL ANY SECOND PARTY EQUIPMENT BE ATTACHED OR INSTALLED IN THE PBPU WITHOUT THE PBPU OEM WRITTEN AUTHORIZATION.
- (c)** During installation or VA Proof of Performance testing and certification: if a PBPU is found to have equipment installed or attached THAT VIOLATES ITS UL RATINGS, IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO RESTORE THE RESPECTIVE UL RATING(S) PER PBPU OEM'S AND UL'S WRITTEN INSTRUCTIONS, AT THE CONTRACTOR'S EXPENSE. Once the corrections are made, each affected unit shall be re-inspected by TVE-005OP3B at the Contractor's Expense. Contact TVE-005OP3B for technical assistance.
- (d)** Install PBPU(s) as required. Refer to VA Master Specification 10-25-13 for specific requirements.

9.3.1 PBPU INSTALLATION

- (a)** All PBPUs shall be surface mounted on the patient headwall.
- (b)** All installations for one bedroom shall be at the head and to the corridor side of the bed.
- (c)** All PBPUs to be located between a pair of beds in multi-bed areas shall be centered between the beds. If an odd bed remains, apply the one-bedroom concept.

9.3.2 PBPU APPLICATION

Table 9-1 describes the type and quantity of PBPUs in different bed areas.

Table 9-1 PBPU Application

BED AREA	TYPE	QUANTITY
ALCOHOL TREATMENT UNIT		Not Required
AMBULATORY CARE		
Observation and Treatment Room	PBPU-Style A1	Each Bed
Life Support	PBPU-Style C	Each Bed
Minor Operating Room		Not Required
DOMICILIARY UNIT		Not Required
DRUG DEPENDENCY TREATMENT UNIT		Not Required
DIALYSIS CENTER		
One-Bed Room	PBPU-Style B2	Each Bed
Multi-Bed Room	PBPU-Style B2	Each Bed
INTENSIVE CARE UNITS		
Coronary	PBPU-Style C	Each Bed
Surgical	PBPU-Style C	Each Bed
Medical	PBPU-Style C	Each Bed
General Purpose	PBPU-Style C	Each Bed
NURSING HOME CARE UNIT		Not Required
NURSING UNITS		
Intermediate Care	PBPU-Style A1	Each Single Bed
Intermediate Care	PBPU-Style A2 (25% of total beds in unit)	Between Each Pair of Beds
MS&N (Medical, Surgical Neurological, Ortho., and RHMS)	PBPU-Style A1	Each Single Bed
MS&N (Medical, Surgical Neurological, Ortho., and RHMS)	PBPU-Style A2	Between Each Pair of Beds
PSYCHIATRIC		Not Required
RESPIRATORY CARE	PBPU-Style B1 (90 percent of total beds in unit)	Each Bed
Monitored Beds	PBPU-Style C (10 percent of total beds in unit)	Each Bed
SPINAL CORD INJURY UNIT	PBPU-Style A1	Each Bed
Medical Isolation	PBPU-Style C	Each Bed
Acute/Respiratory Care	PBPU-Style C	Each Bed
SURGICAL RECOVERY ROOM	PBPU-Style B1	Each Bed

9.4 MEDICAL GAS, VACUUM, AND AIR ALARM SYSTEMS

- (a)** Provide two master alarm signal panels for nonflammable medical gas, medical-surgical vacuum, and laboratory air and laboratory vacuum systems in separate warning locations. Provide master alarm panels at the Telephone Switchboard and Engineering Control Center. If an Engineering Control Center is not provided, install master alarm panels at the Security Office or other suitable location that is continuously staffed.
- (b)** Provide area alarms at Nurse Stations in locations where nonflammable medical gas and medical-surgical vacuum systems are installed.
- (c)** NFPA 99 allows one of the two required alarm systems to be computerized. If this option is chosen by the A/E, VA prefers that the computerized system be the HVAC control system, if UL-listed for this application. Addressable fire alarm systems shall be permitted to monitor medical gas alarms provided that the alarm signals are programmed as a supervisory signal (shall not initiate the building fire alarm system).

This page intentionally left blank.

APPENDIX A: ILLUMINATION LEVELS

APPENDIX A: ILLUMINATION LEVELS

APPENDIX A – ILLUMINATION LEVELS	
AREA DESCRIPTION	LIGHTING LEVEL (fc) *
ACTIVITIES ROOM AND DINING SPACE	50
AGENT CASHIER	30
AIRLOCK (ANTE ROOM)	10
AMBULATORY CARE	
AMB. SURGERY OR	300-1000k
• CONSULTATION	30
• EXAMINATION/TREATMENT	50l
• LIFE SUPPORT UNIT	
○ GENERAL	30
○ OVER BED	50a, d, h
• MULTIPURPOSE EXAMINATION	50l
• OBSERVATION AND TREATMENT	
○ GENERAL	10
○ OVER BED	50a, h
○ OVER HEAD OF BED	30
• SCREENING PROCTOSCOPY AND SIGMOIDOSCOPY	50
• SECURITY EXAMINATION	50h
ANESTHESIA	
• ANESTHESIOLOGY PREPARATION	50l
• STORAGE	10
• WORKROOM, ANESTHESIA AND EQUIPMENT STORAGE	30
ANIMAL HOUSING AREA	20-60d
APPARATUS AND EQUIPMENT STORAGE	30
AUDIOMETRY ROOM AND TEST ALCOVE	50
AUDITORIUM	
• SOCIAL ACTIVITIES	5
ASSEMBLY	10
AURAL REHABILITATION/SPEECH PATHOLOGY THERAPY	50
AUTOPSY AND MORGUE	
• AUTOPSY	300-1000a
• ISOLATION/TEACHING AUTOPSY	300-1000a
• MORTUARY REFRIGERATOR(COLD ROOM)	30
BARBER SHOP	50
BARIUM PREPARATION	50
BATHROOM	10b
BEAUTY SHOP	50
BEDROOM	
• NON-PATIENT	5
• PATIENT (SEE PATIENT ROOMS)	

APPENDIX A: ILLUMINATION LEVELS

BILLIARD ROOM	10; Table 30
BLOOD SPECIMEN COLLECTION	50
BOILER ROOM	10; Burner Platforms 20
CANTEEN	
• FOOD SERVICE AREA (SEE FOOD SERVICE)	
• KITCHEN (SEE FOOD SERVICE)	
• RETAIL STORAGE AND RECEIVING	30
• RETAIL STORE	50
• VENDING MACHINE AREA	10
• WARD CART STORAGE	10
CAN WASH AND CAN CRUSHER(SEE FOOD SERVICE)	
CARDIAC PROCEDURE/CATHETERIZATION	10d, i
CARDIOPULMONARY REHABILITATION CTR.	50
CART STORAGE	10
CAST ROOM	50
CHAPEL	
• ALTAR/ARK/REREDOS	100
• CHANCEL(INCLUDING ALTAR & CHOIR)	30
• CHOIR ROBIN	10
• EUCHARISTIC AND DEVOTIONAL	20
• NAVE	30
• SACRISTY	20
CLASSROOM	50
CLEAN CAGE STORAGE	10
CLEAN LINEN	10
CLEAN LINEN SORTING	30
CLEAN UTILITY/SUPPLIES	20
CLEAN UTILITY/SPD CART	10
CLINIC, EVALUATION	50
CLINIC SPACE, LEARNING STATIONS	50
CLINIC SPACE, VOC. REHABILITATION THERAPY	50
CLOSETS	
• ELECTRICAL	10
• GENERAL	10
• HOUSEKEEPING AIDS	10
• HOUSEKEEPING AIDS(SURGERY)	20
• LINEN	10
• PLASTER AND SPLINT	30
• SIGNAL	10
• CLOTHING CHANGE	20
CONFERENCE/CLASSROOM	50
CONFERENCE ROOM	50
CONGREGATE BATH/TOILET/HOPPER	30b

APPENDIX A: ILLUMINATION LEVELS

CONSULTATION	50
CONSULTATION/MEDICATION/CHART	50
CONSULTATION, VIEWING AND TEACHING	50c
CONTROLLED TEMPERATURE ROOM	20
CONTROL ROOMS	
• CONTROL AREA (RAD. THERAPY)	20
• CONTROL BOOTH/ALCOVE (X-RAY)	10
• CONTROL CENTER (INTENSIVE CARE)	30-50
• CONTROL STATION (SURGERY SUITE)	70
CORRIDORS	
• DENTAL SUITE	30
• GENERAL NON-NURSING	5
• GENERAL NURSING	Day 10; Night 5
• LABORATORIES	30
• QUARTERS	15
• SURGICAL SUITE	50
COUNSELING/TREATMENT	
CRAWL SPACE	3
CREDIT UNION	50
CYSTOSCOPIC ROOM (NON-SURGERY)	
• GENERAL	50i; Table Surgery Light-c
• DARKROOM: DEVELOPING, PRINTING AND ENLARGING	0-10c, g
• DAY ROOM	20-50
• DECONTAMINATION	30
DENTAL SUITE	
• DARKROOM	0-50
• DENTAL OFFICE	30
• DENTAL RESIDENTS AND TRAINEES STUDY/CONFERENCE ROOM	30
• EXAMINATION, HYGIENE AND GENERAL TREATMENT OPERATORIES	50-100a
• INSTRUMENT PREPARATION AND STERILIZATION	50
• ORAL SURGERY	300-1000a
• PATIENT INTERVIEW	30
• PREVENTIVE DENTISTRY	50a
• PROSTHETIC LABORATORY	5a; Local, 150a; Impressions 200
• RECOVERY	70a
• RESEARCH LABORATORY	150a
• SOILED SPD CART HOLDING	30
• SUPPLY ROOM	30
• X-RAY AREA	50a

APPENDIX A: ILLUMINATION LEVELS

DIALYSIS CENTER	
• BEDROOM (MULTI-BED)	20
○ LOCAL OVER BED	50
○ LOCAL OVER ARM	100
○ OVER HEAD OF BED	30
• DIALYSATE PREPARATION	50
• DIALYSIS TRAINING(SEE BEDROOM ABOVE)	
• EQUIPMENT SERVICE AREA SOILED/CLEAN	30
• EQUIPMENT SERVICE AREA STORAGE	10
• FINAL WATER TREATMENT	30
DISPENSING (SEE PHARMACY)	
DRESSING/RECOVERY	50i
DRESSING ROOM	10
DRESSING/TOILET	10b
EAR, NOSE AND THROAT CLINIC (ENT)	
• AUDIOMETRY ROOM AND TEST ALCOVE	50
• EXAMINATION AND TREATMENT	50
• STERILIZATION,PREPARATIONS AND STORAGE	50
ELECTROCARDIOGRAPHIC (ECG)	
• GENERAL	15e
• MACHINE	30
ELECTROENCEPHALOGRAPHIC (EEG)	
• EEG INSTRUMENT AND WORKROOM	50
• EXAMINATION	50
• PHYSICIANS READING	50
• PREPARATION	50
ELECTROMYOGRAPHIC (EMG)	30a
ELECTRON MICROSCOPE SUITE	
• CUTTING ROOM	200
• PREPARATION	100a
• SCOPE ROOM	30c
ELEVATORS	5
EMERGENCY GENERATOR	10
ENDOSCOPY	
• UPPER AND LOWER GI	50c, i
• WORKROOM	50
ENGINEERING CONTROL CENTER	30
ENTRANCE (SEE LOBBY)	
ENTRANCE (EXTERIOR)	5
EQUIPMENT STORAGE	10
EQUIPMENT STORAGE AND TESTING	20-100
ESCORT SERVICE	30
EXAMINATION AND TREATMENT	50i, k
EXAMINATION/CONSULTATION	50i

APPENDIX A: ILLUMINATION LEVELS

EXERCISE ROOM	30
EXITS (AT FLOOR LEVEL)	5
EYE CLINIC	
• EXAMINATION AND TREATMENT	50
• REFRACTION AREA	20g
• SURGERY	300-1000
• VISUAL FIELD/DARKROOM ADAPTATION	0-50c
FILM PROCESSING	30; Local 0-10c
FLAMMABLE OR TOXIC STORAGE	10
FOOD SERVICE	
• BULK FOOD CARTS	10
• CART WASH CENTER	20
• CLEAN DISH STORAGE	10
• COLD FOOD AND DESSERT PREPARATION	50
• DIETITIANS	50
• DIETETICS - SERVING UNIT	50
• DINING ROOM/AREA/SPACE	30
• DINING ROOM/RECREATION AREA	30c
• DISHWASHING AREA/UNIT	30
• FIXED SERVING LINE	30; Display 50
• FOOD PROCESS AND PREPARATION	50
• FOOD STORAGE	30
• INGREDIENT CONTROL AREA	50
• KITCHENETTE	50
• MAIN KITCHEN	50
• KITCHEN SERVING	50
• LUNCH AREA WITH KITCHEN UNIT	30
• LUNCH ROOM	30
• MEAT AND VEGETABLE UNIT	50
• MOBILE SERVING LINE	50
• NUTRITION CLINIC	30
• POT WASHING CENTER	30
• REFRIGERATED AND FROZEN STORAGE	5
• REFRIGERATED GARBAGE AND TRASH STORAGE	5
• SANITATION SUPPLY STORAGE	5
• SERVING LINE	30; Display 70
• SERVING UNIT WORK AREA	30
• SOILED DISH COLLECTION	10
• SPECIAL NOURISHMENT PREPARATION	100
GAME AND ACTIVITY ROOM	30
GAS STORAGE	10

APPENDIX A: ILLUMINATION LEVELS

GROSS SPECIMEN STORAGE	10
GI SCREENING PROCTOSCOPY/SIGMOIDOSCOPY ROOM	100
GU CARE ROOM	50
GU EXAMINATION/TREATMENT	50-100i
HEALTH RECORDS STORAGE	10
HOSPITAL PLANS AND DRAFTING	50
INACTIVE RECORDS STORAGE	10
INFORMATION COUNTER	30
INSTRUMENT CALIBRATION AND STORAGE	50
INTENSIVE CARE (SEE PATIENT ROOMS)	
INTERVIEW/CONSULTATION	30
INTERVIEW - EXAMINATION	70
ISOLATION BEDROOM(RECOVERY/ICU)	10; Local 70
KITCHENETTE/MULTIPURPOSE	30
LABORATORIES; GENERAL	50
• BENCH AND TABLE TOP LIGHTING	50
• BIOCHEMISTRY	50
• BIOSAFETY	50
• CARDIAC BLOOD GAS ANALYSIS	50
• CHEMISTRY	50
• CLINICAL CHEMISTRY/MICROBIOLOGY	50
• COAGULATION	50
• CYTOLOGY	50
• DERMATOLOGY	50
• DIAGNOSTIC	50
• ENVIRONMENTAL	50d
• FROZEN/AND GROSS SECTION	50
• HIGH/LOW LEVEL IN-VITRO COUNTING	100
• HISTOLOGY	50
• IMMEDIATE RESPONSE (STAT)	50i
• IMMUNOPATHOLOGY	50
• MICROBIOLOGY	50
• MYCOBACTERIOLOGY (TB)	50
• MYCOLOGY	50
• ORTHOTICS	50i
• PHARMACEUTICAL EXPERIMENTATION	50
• PHYSICS	50
• PROCEDURAL	50
• PULMONARY BLOOD GAS	50
• RADIOIMMUNOASSAY (RIA)	50

APPENDIX A: ILLUMINATION LEVELS

• BENCH AND TABLE TOP LIGHTING	
○ ROUTINE (HEMATOLOGY)	50
○ SPECIAL CHEMISTRY	50
○ SPECIMEN ACCESSIONING, PROCESSING AND DISTRIBUTION	50
○ STUDENT LABORATORY-CLASSROOM	50g
○ URINE (URINALYSIS) AND FECES	50
○ URODYNAMICS	50; Table, Minor Surgery Light
LAUNDRY	
• CART WASHER AREA	30
• CENTRAL LIQUID SUPPLY SYSTEM	10
• CLEAN LINEN HOLDING(FLOW RACK) AND ASSEMBLY AREA	300
• CLEAN LINEN PROCESSING AREA	30
• DISTRIBUTION AREA(CART STORAGE, DISPATCH AND DOCK)	20
• GENERAL ADMINISTRATIVE AREA	30
• LINEN COLLECTION	20
• LINEN PACK PREPARATION	30
• LINEN REPAIR AREA	100
• LINEN STORAGE	10
• LUNCH ROOM/TRAINING ROOM	30
• PRODUCTION AND SUPPORT AREA	30
• RECEIVING AREA	30
• SORTING AND WASHING AREA	30
• UNIFORM EXCHANGE (AUTOMATED)	10
LIBRARY; GENERAL	30
• AUDIOVISUAL ROOM	30j
• CIRCULATION/REFERENCE DESK	30
• LIBRARIAN	50
• MICROFORM AREAS	30
• PHOTOCOPY AREA	30
• SEATING SPACE (READER STATIONS)	30
• SHELVING/STACK AREAS	30
• WORKROOM/TECHNICAL SERVICES	50j
LINEN	
• CLOSET	10
• LINEN ROOM AND CLEAN SPD CART	30
• LINEN SERVICE	30
• SEAMSTRESS SPACE	70
• SOILED COLLECTION	30
• SOILED COLLECTION AND CENTRAL SORTING	30
• SOILED LINEN HOLDING AREA	10
• SOILED LINEN ROOM	10

APPENDIX A: ILLUMINATION LEVELS

LOADING DOCK	10
LOBBY/FOYER	Day 20; Night, 10
LOCKER ROOMS	10
LOUNGES	
• READING	30
• PATIENT'S LOUNGE AND TV ROOM	20
MAIL ROOM AND DISTRIBUTION CENTER	50
MAIL ROOM/UNIT	50
MAINTENANCE/SHOPS (SEE SHOPS)	
MEDICAL AND GENERAL STORAGE (SEE STOREROOM)	20
MEDICATION AND TREATMENT	100g, i
MEDICAL MEDIA PRODUCTION	
• CAMERA ROOM	30
• DARKROOM, FILM PROCESSING	30 Local 0-10c
• FINISHING ROOM	50a
• GRAPHICS ILLUSTRATION ROOM; ILLUSTRATION PREP. AREA	70i; Tables 2000
• PHOTOMICROGRAPHY	30
• PRINTING AND ENLARGING	30; Local 0-10c
MEDICAL RESEARCH STORAGE (SEE STOREROOM)	
MINOR OPERATING ROOM	200h
MULTIPURPOSE ROOM	30
MUSIC ROOM	30
NOURISHMENT KITCHEN	50
NUCLEAR MEDICINE	
• COMMON VIEWING AND CONFERENCE	30
• EQUIPMENT CALIBRATION	50; Bench Tops 70
• ISOTOPIC STORAGE AND PREPARATION AREA	50
• RADIOPHARMACY	70
• RECTILINEAR ORGAN SCAN	0-50; 0-10d
• SPECIAL PROCEDURE	0-50; 0-10d
• STATIONARY IMAGING	0-50; 0-10d
• THYROID UPTAKE	0-50; 0-10d
• WALK-IN REFRIGERATOR	20
NURSE'S STATION/WARD CLERK/DOCTOR'S CHARTING	
• GENERAL; DAY	50
• DESK/TABLE/COUNTER	50
OFFICES; GENERAL	30
OFFICES; STAFF	50
OFFICES; WORKSTATION CLERICAL OR TECHNICAL STAFF	30
ON-CALL ROOM	10g
ONCOLOGY CHEMOTHERAPY AGENT PREPARATION	100

APPENDIX A: ILLUMINATION LEVELS

ONCOLOGY CHEMOTHERAPY TREATMENT	100
OPERATING ROOMS (SEE SURGERY SUITES)	
ORTHOPEDIC CAST ROOM	50 work area; 100 cubicle
OXYGEN STORAGE	10
PARKING GARAGE	
• ENTRANCE; DAY	50 Day; 1 Night
• GENERAL TRAFFIC, PARKING AND PEDESTRIAN AREAS	2 Day; 1 Night
PATIENT ROOMS	
• GENERAL	5
• ANTEROOM (ISOLATION)	10
• BATH, PRIVATE OR CONNECTING	30b
• NIGHT OBSERVATION	3
• OVER-BED TASK ILLUMINATION	50a, c, f
• OVER HEAD OF BED	30f
• PATIENT LOCKER AREA	10
• SECURITY/SECLUSION BEDROOM	10
• SERVICE ALCOVE	5
• TOILET	30b
PHARMACY	
• CONTROLLED SUBSTANCES VAULT AND SECURED DISPENSING	70
• DRUG RECEIVING	70
• DRUG UTILIZATION REVIEW	70
• EXTEMPORANEOUS COMPOUNDING	100
• EXTEMPORANEOUS REPACKAGING	50
• FILING AND ASSEMBLY	100
• HEMODIALYSIS (STORAGE)	30
• INTERVENOUS ADMIXTURE AND ASEPTIC TRANSFER	100
• MEDICATION ASSIGNMENT	70
• MEDICATION PREPARATION AREAS	70
• POISON CONTROL STORAGE	30
• PREPACKAGING	100
• PRESCRIPTION RECEIVING	70
• PROSTHETICS AND MEDICAL SUPPLIES	30
• RECEIVING	70
• RECEIVING,STORAGE AND RECORD CONTROL	70
• STAT	100; Counter 70
• STERILE FLUIDS AND ADMIXTURE SETS STORAGE	30
• SUPPORT AREA	70
• UNIT DOSE DISPENSING	100
• VAULT (DRUGS)	30

APPENDIX A: ILLUMINATION LEVELS

PHONO- CARDIOGRAPHY	30; Machine 50
PLASTER AND SPLINT CLOSET	10
PNEUMATIC TUBE EQUIPMENT ROOM	20
POST OPERATIVE/RECOVERY WARD (RESEARCH)	75g; Work Space 100
PROJECTION, PREPARATION AND STORAGE	0-30c
PREFABRICATED SOUND SUITE-CONTROL ROOM	0-30d
QUIET AREA (PSYCHIATRIC)	50g
QUIET ROOM	30
RADIOLOGY SUITE	
• ANESTHESIOLOGY PREPARATION AND RECOVERY	50l; Over Beds 70a, f
• AUTOMATED ROOM	30; dimmable CFL 0-10d
• BARIUM PREPARATION	50
• CENTRAL SILVER COLLECTION AREA	30
• COMPUTERIZED AXIAL TOMOGRAPHY (CT)	30; dimmable CFL 0-10d
• CONTROL BOOTH/ALCOVE	10
• DARKROOM	0-10d
• DEDICATED CHEST ROOM	30; dimmable CFL 0-10d
• EXAMINATION ROOM/AREA	50
• FILM LIBRARY	50
• FILM STORAGE UNDEVELOPED	10-30
• MEGAVOLTAGE UNIT	10-30
• PROCESSING AREA	50
• RADIATION THERAPY	10
• SCRUB ROOM	70
• SPECIAL PROCEDURES	
○ FLUORESCENT	0-50
○ INCANDESCENT	0-10d
• SUPERFICIAL THERAPY UNIT AND CONTROLS	10-30
• SUPERVOLTAGE UNIT (COBALT 60)	10-30
• ULTRASOUND	50; dimmable CFL 0-10c
• VIEWING ROOM COMMON	20j
• X-RAY ROOMS	30; dimmable CFL 0-10d
RECEIVING AND CLEANING	30; Benches, Tables, etc. 70
RECEIVING AND ISSUE AREA	30
RECEIVING AND SHIPPING DOCK	20
RECEPTION AND WAITING	10
RECOVERY ROOM (SEE SURGERY SUITE)	
RECREATION/MULTIPURPOSE ROOM	30
RESIDENT CLOTHING AND LUGGAGE STORAGE	10
RESIDENT'S LAUNDRY	30

APPENDIX A: ILLUMINATION LEVELS

SCRUB ALCOVE	100
SEAMSTRESS	500
SHOPS, MAINTENANCE AND REPAIR	
• AIR CONDITIONING SHOP	50
• CARPENTER SHOP	50
• ELECTRICAL SHOP	50
• GROUNDS MAINTENANCE SHOP	30
• MACHINE SHOP	50
• MASON SHOP	30
• PAINT SHOP	50
• PARTS AND TOOLS CLERK	30
• PLUMBING SHOP	50
• REPAIRING AND DEVELOPMENT	50
• STORAGE (SEE STOREROOMS)	
SHOWER	30
SITZ BATH	30
SPECIMEN TOILET	30b
SOILED UTILITY/SPD CART	10
STAGE (GEN. ILLUM.)	30
STAIRWAYS	20
STERILIZATION AND SOLUTION PREPARATION	50
STOREROOMS	
• FINE	30
• MEDIUM	10
• BULKY	5
STRETCHER AND WHEELCHAIR STORAGE	5
STRETCHER WAITING SPACE	5
SUBSTERILIZATION AND WORK AREA	50
SUPPLY PROCESSING AND DISTRIBUTION (SPD)	
• AUTOMATIC CART WASH	20
• BULK STORAGE AREA	10
• CLEAN RECEIVING AND BREAKOUT	30
• CLEAN SIDE	30
• DISPATCHERS CONTROL STATION/OFFICE	30
• INSPECTION AND PREPARATION OF SURGICAL LINEN AND PACKS	50
• MANUAL EQUIPMENT WASH	30
• PREPARATION ASSEMBLY AND STERILIZATION	30
• SOILED RECEIVING AND DECONTAMINATION	30
• STERILE/NON-STERILE STORAGE	30
• STERILIZATION AND PREPARATION	30
• VOLUNTEER AND TRAINING	30
• WORK STATION/COMPUTER	30e

APPENDIX A: ILLUMINATION LEVELS

SURGICAL SUITE	
• CLEAN AND STERILE SUPPLIES	30
• CLEAN CORE SUPPORT AREA	50
• CONTROL ROOM(CYSTOSCOPIC)	30
• DICTATION CUBICLE	30
• EQUIPMENT AND APPARATUS STORAGE	20
• EXTERNAL RADIOGRAPHIC CONTROL ROOM	10
• OR HOUSEKEEPING AIDS CLOSETS	10
• OPERATING ROOMS CARDIAC; CYSTOSCOPIC; GENERAL PURPOSE; NEUROSURGERY; ORTHOPEDIC	300-1000h
• PATIENT HOLDING ROOM OR ALCOVE	50c
• PUMP TECHNICIAN'S PREPARATION ROOM	70
• RECOVERY	50i; Over Beds 100a, f
• SCRUB-UP ALCOVE	100
• SOILED HOLDING AREA	30
• SPECIAL EQUIPMENT RECORDING ROOM	30
• WORKROOM, ANESTHESIA AND EQUIPMENT STORAGE	30
SWITCHGEAR	10
TELECOMMUNICATIONS	
• HEAD END ROOM	30
• MAIN COMPUTER ROOM	70; at 20" aff
• TELECOMMUNICATIONS ROOMS	50
• TELEPHONE EQUIPMENT ROOM	70; at 20" aff
• TELEPHONE CONSOLE ROOM	30
THEATER	10c
• SUPPLEMENTAL	20
• FOYER	5
THERAPY	
• CORRECTIVE CLINIC	50
• EDUCATIONAL/VOCATIONAL	50
○ ASSIGNMENT SPACE	50
○ COMPENSATED WORK THERAPY CLINIC	50
○ EVALUATION	50
• INSTRUCTION, ORIENTATION & SIMULATOR SPACE (DRIVER TRAINING)	50
○ PATIENT REST AREA	30
• GROUP THERAPY ROOM	30
○ TABLE	50
○ CONFERENCE RM	50c

APPENDIX A: ILLUMINATION LEVELS

• INHALATION	30
○ OCCUPATIONAL	
○ CLINICAL	30; Bench, 50, Fine 100
○ ORTHOTIC AND SPLINTING AREA	50
• PHYSICAL	
○ ARM AND LEG WHIRLPOOLS	30
○ CLINIC	50
○ HUBBARD TANKS	30
○ HYDROTHERAPY	30
○ SPECIAL TREATMENT	70
○ TABLES AND INDIVIDUAL EXERCISE	30
○ TREATMENT AREA	50
• RADIATION	
○ ORTHOVOLTAGE THERAPY UNIT	30; dimmable CFL 0-10d
○ PATIENT PRETREATMENT	50
○ RADIUM SEALED SOURCE ROOM	30
○ SIMULATOR	30
○ TREATMENT AREA	50g
○ TREATMENT PLANNING AREAS	70
○ VIEWING AND CONSULTATION	30-50
• RECREATION	
○ ARTS, CRAFTS AND HOBBY	30
○ MULTIPURPOSE RECREATION	50
• SPINAL CORD INJURY	
○ CLINIC	50
○ HUBBARD TANKS	30
○ WHIRLPOOL, ARM, LEG AND LO-BOY	30
THERAPEUTIC POOL	30; Apron 40
TOILETS	30b
TRAINEE/STUDENT STUDY CUBICLE	30
TRANSFORMER ROOM	10
TRASH/COLLECTION ROOM	10
TUB ROOM	30
ULTRASOUND DIAGNOSIS	30
UNIFORMS	20
URINE TESTING ALCOVE	50
UTILITY AREAS	10
VAULT	30
VECTORCARDIOGRAPHY	50
VENDING/MACHINE AREA/ALCOVE	10
VENTILATORY TEST	30a; Desk Area 75a

APPENDIX A: ILLUMINATION LEVELS

VESTIBULE	10
VESTIBULE AND WAITING AREA	10
VOLUNTEER/ESCORT SPACE	30
VOLUNTEER SIGN-IN	30
WAITING ROOMS	30
WALK- IN REFRIGERATOR (COLD ROOM)	10
WARD CLERK	30
WARD SUPPLY	30
WHEELCHAIR AND SPECIAL BED STORAGE	10
WHEELCHAIR AND STRETCHER	10
WORD PROCESSING/COMPUTER ROOM	30e
WORKROOM AND DRESSING ROOM	30
WORK STATION (COMPUTER)	30e

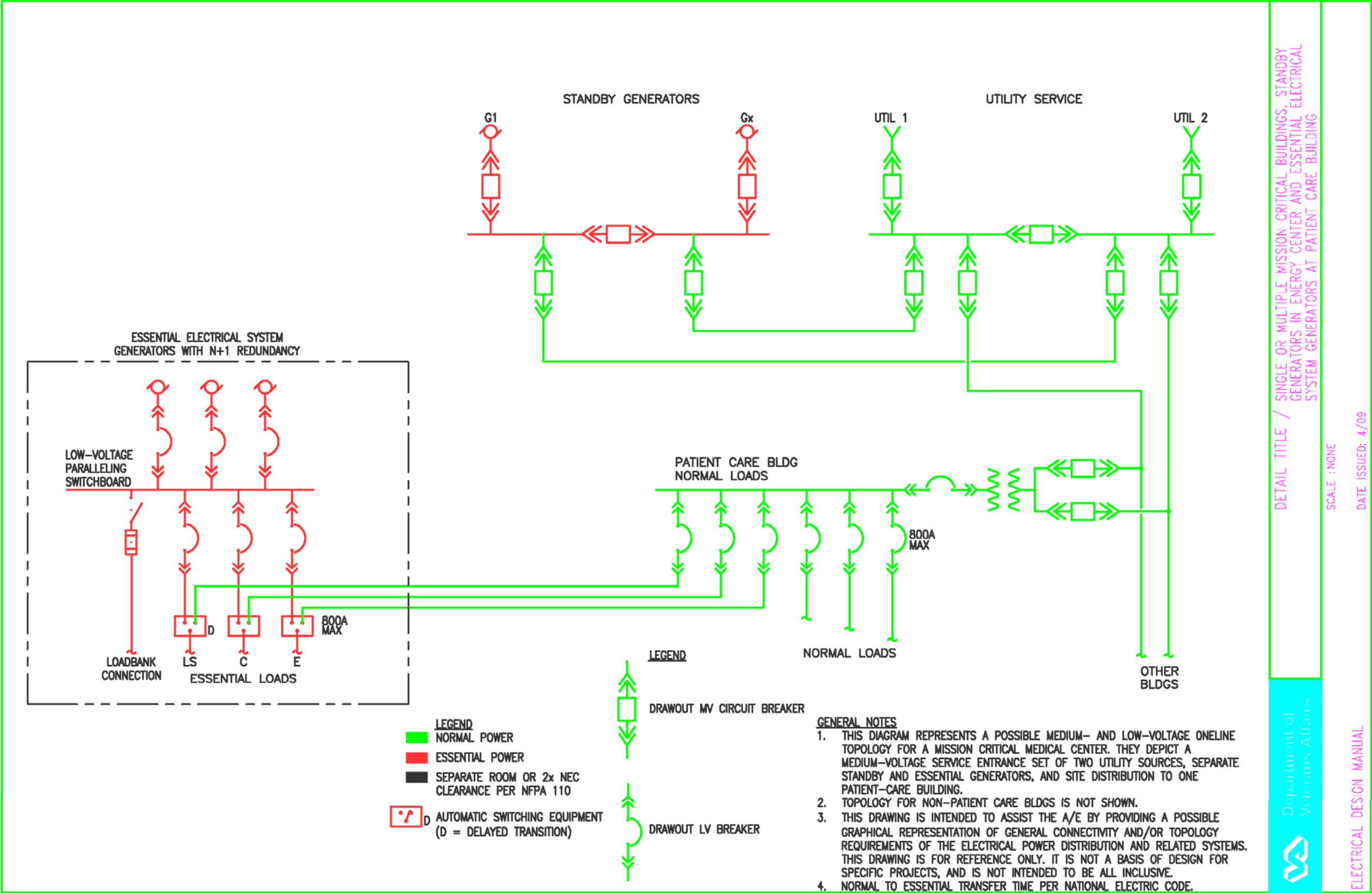
Notes:

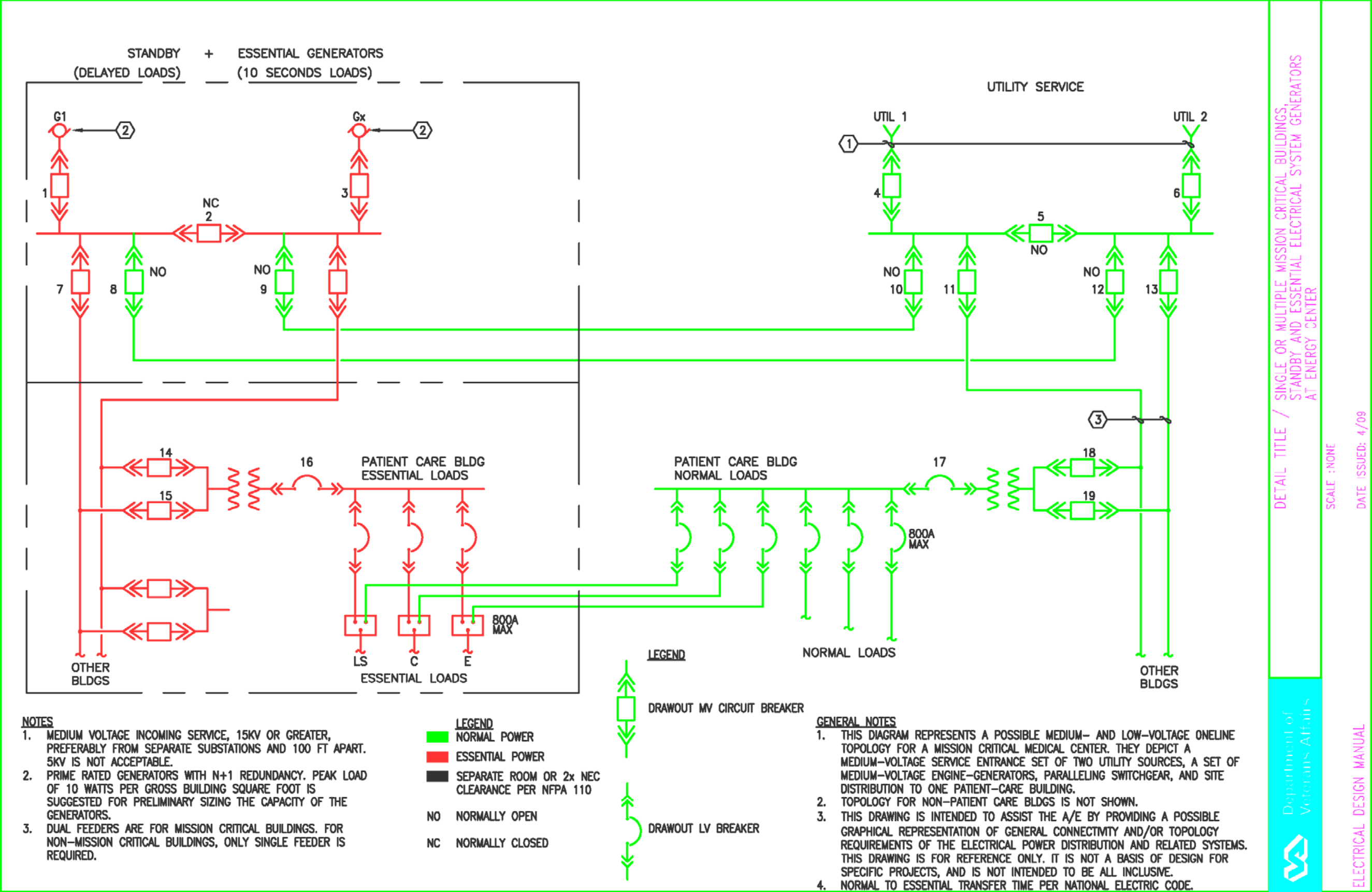
- a. Provide illumination by fluorescent lamps producing light between CRI ratings 90 and 100. Base design on the lower lumen ratings of these lamps.
- b. Footcandle value is for general illumination. If deemed necessary, provide supplemental lighting for mirrors and close inspections.
- c. Vary illumination levels by dimmer control devices.
- d. Light dimming shall be in accordance with specific project requirements.
- e. Provide indirect illumination.
- f. Control bed lighting individually.
- g. Footcandle value is for general illumination. Provide additional localized lighting as required.
- h. Fluorescent lamps shall be of the color improved type, and shall essentially match the color temperature of the surgical light(s)
- i. Fluorescent lamps shall be of the deluxe color improved type
- j. Supplemental lighting may be required at task locations.
- k. See exceptions under specific clinics.

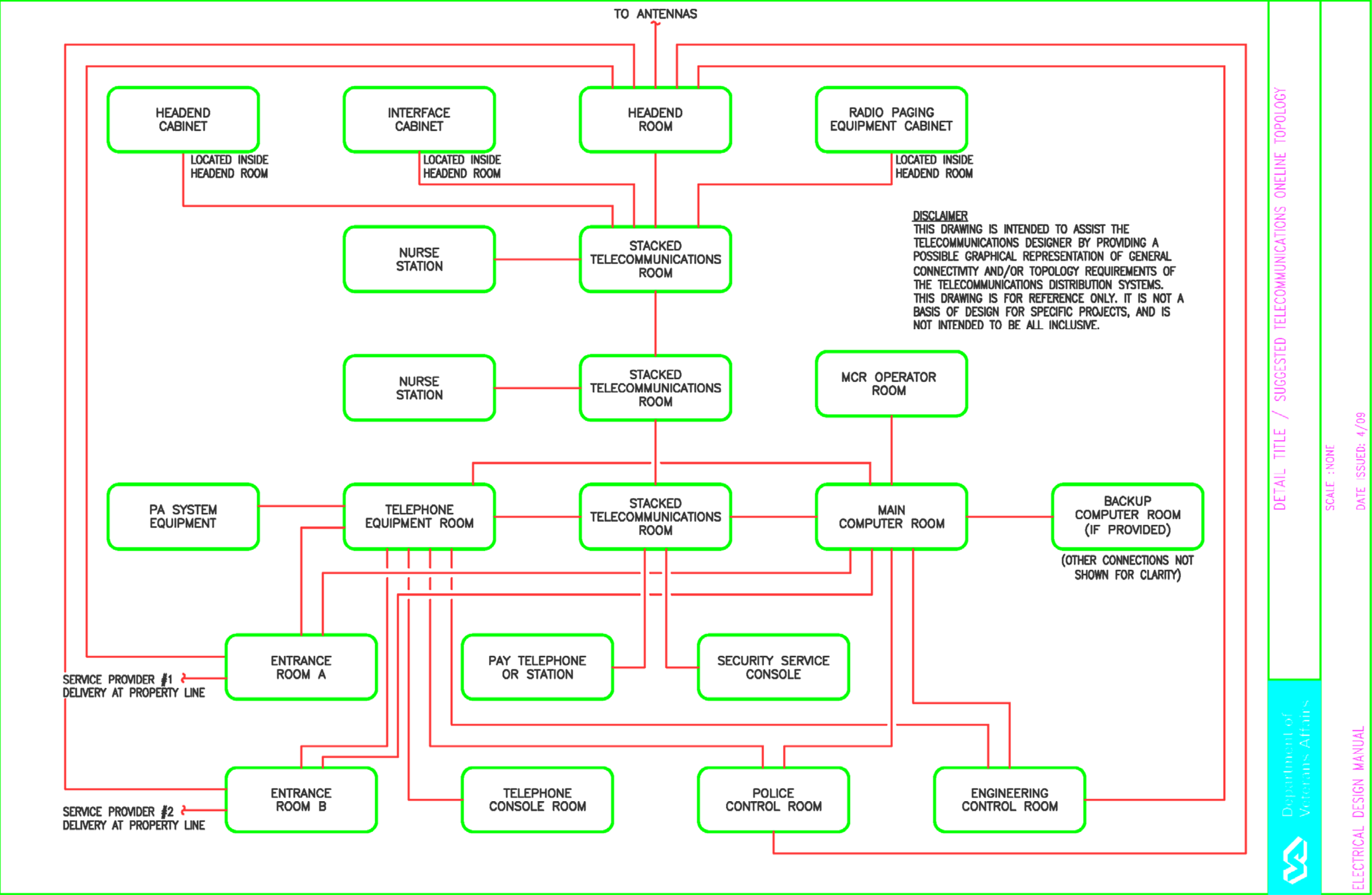
This page intentionally left blank.

APPENDIX B: DRAWINGS

This page intentionally left blank.







INDEX

ACUTE NURSING, CRITICAL BRANCHLOADS	4.6.1.2(a)
ALARM SYSTEM (GAS, VACUUM, AIR)	9.9
ANESTHETIZING LOCATION, CRITICAL BRANCH	4.6.1.2(b)
ANGIOGRAPHIC LABS, CRITICAL BRANCH	4.6.1.2(c)
AUDIO-VISUAL NURSE CALL	
Cable Trays	7.5
Cellular Floors	7.7
Conduit and Boxes	7.4
Drawings and Details	7.11
Ducts (Telecommunications)	7.7
Enclosed Cable Trays	7.6
Enclosed Wireways	7.6
General Installation Requirements	7.10
General Requirements	7.2
Head End Equipment Room	7.12
Open Wireways	7.5
Stations-Non Patient Wards	7.18(a)
Terminal Cabinets	7.9
Wires and Cables	7.3
AUTOMATIC TRANSFER SWITCHES	
Requirements	4.6.4
Seismic Bracing	1.12.3(a)
BLOOD BANK, CRITICAL BRANCH	4.6.1.2(d)
BOILER PLANT METERING	5.1.1.1(a)
BONE BANK, CRITICAL BRANCH	4.6.1.2(d)
BUSWAY	
Seismic Bracing	1.12.3(e)
CABLE TRAY	
Seismic Bracing	1.12.3(b)
CALCULATIONS	1.11
Generator Set Sizing	1.11(d) Lighting
1.11(e)	
Load Calculation	1.11(c)
Protective Device Study	1.11(b)
Seismic Bracing	1.11(f)
Short Circuit	1.11(a)
Voltage Drop	1.11(g)
CARDIAC CATHERIZATION, CRITICAL BRANCH	4.6.1.2(e)
CHILLER BUILDING METERING	5.1.1.1(a)
CODES AND STANDARDS	1.5
ANSI	1.5.1(a)
ASTM	1.5.1(b)
IEEE	1.5.1(g)

IESNA	1.5.1(f)
Local Codes	1.5.2
NEMA	1.5.1(l)
NFPA	1.5.1(j)
UL	1.5.1(o)
CONDUCTORS	
Isolated Power System	2.7(b)
See "GROUND"	Page (I-5)
Size	2.7
Type	2.7
CONDUIT	
Concealed	2.2
Exposed	2.2
Seismic Bracing	1.12.3(c)
Underground, Direct-burial	2.3(b)
Underground, Encased	2.3(a)
COORDINATION	
Architectural	1.3(a)
Civil	1.3(a)
Mechanical	1.3(a)
Sanitary	1.3(a)
Site	1.3(a)
Structural	1.3(a)
Utility Company	1.3(b)
CORONARY CARE UNIT, CRITICAL BRANCH	4.6.1.2(f)
COMMUNICATION SYSTEMS	
Cable Trays	7.5
Cellular Floors	7.7
Conduit and Boxes	7.4
Drawings and Details	7.11
Ducts	7.7
Enclosed Cable Trays	7.6
Enclosed Wireways	7.6
General Requirements	7.2
Head End Equipment Room	7.12
Installation Requirements	7.10
Open Wireways	7.5
Terminal Cabinets	7.9
Wires and Cables	7.3
DENTAL SUITE, CRITICAL BRANCH	4.6.1.2(w)
DISCONNECT SWITCHES	
Motors	2.9
Seismic Bracing	1.12.3(d)
DISTRIBUTION SYSTEM	5
Electrical Service, Underground	5.2.1(a)
Electrical Utility Service	5.2.1
Load Calculations	1.11(c)
Maximum Service Voltage	5.2.1(b)

Minimum Riser Drawing Requirements	1.9(h)
Primary Service and System Distribution (One Line Riser Diagram)	1.9(g)(4)
Protective Device Study	1.11
Secondary System Distribution (Riser Diagram)	1.9(g)(5)
See "Electrical Service"	Page (I-3)
See "Emergency/Essential Systems"	Page (I-5)
Short Circuit Calculations	1.11(a)
Voltage Drop Calculations	1.11(g)
DISTRIBUTION, PRIMARY	5.2.2
Distribution Type	5.2.2(a)
Equipment Location	5.2.2(b)
Equipment type	5.2.2(c)
DISTRIBUTION, SECONDARY	5.2.3
Maximum Substation Sizes	5.2.3(a)
Quarters & Private Dwellings	5.2.3(c)
DOOR CONTROL SYSTEM	
Cable Trays	7.5
Cellular Floors	7.7
Conduit and Boxes	7.4
Drawings and Details	7.11
Ducts	7.7
Enclosed Cable Trays	7.6
Enclosed Wireways	7.6
General Requirements	7.2
Head End Equipment Room	7.12
Installation Requirements	7.10
Open Wireways	7.5
Special Requirements	7.18(g), 7.18(h)
Terminal Cabinets	7.9
Wires and Cables	7.3
DRAWING REQUIREMENTS	1.10.1(b)
Abbreviations & Symbols	1.10.3
Abbreviations and Symbols	1.10.3(a)
Column Grids	1.10.1(d)
Column Numbers	1.10.1(d)
Compass Point	1.10.1(d)
Key Plan	1.10.1(d)
Large-Scale Partial Plans	1.10.1(e)
Notes	1.10.1(c)
Room Numbers	1.10.1(d)
Room Titles	1.10.1(d)
Scale	1.10.1(d)
Schedules	1.10.2(h)
Scope	1.6
Sequence of Drawings	1.10.2
DURESS CALL	
See "EMERGENCY (DURESS) CALL"	
EGRESS DOORS, AUTOMATICALLY OPERATED	
Life Safety Load	4.6.1.1(b)

ELECTRICAL ROOMS/CLOSETS	
Critical Branch	4.6.1.2(x)
Definition	5.2.4(a)
Electrical Closet	3.4.28 or 3.3.28
Existing Buildings	5.2.4(c)
General	5.2.4
Large-Scale Plans	1.10.1(e)
Location	1.9(a)
New Building Requirements	5.2.4(b)
Oil filled Transformer Rooms	5.2.4(d)
ELECTRICAL SERVICE	
Existing Service	1.3(b)(3)
New Service	1.3(b)(2)
Utility Coordination	1.3(b)
ELEVATOR	
Life Safety Load	4.6.1.1(f)
EMERGENCY (DURESS) CALL	
Cable Trays	7.5
Cellular Floors	7.7
Conduits and Interconnection Boxes	7.4
Drawings and Details	7.11
Ducts	7.7
Enclosed Cable Trays	7.6
Enclosed Wireways	7.6
General Requirements	7.2
Head End Equipment Room	7.12
Installation Requirements	7.10
Open Wireways	7.5
Special Requirements	7.18
Terminal Cabinets	7.9
Wires and Cables	7.3
EQUIPMENT SYSTEMS-HOSPITALS	4.6.2
Delayed Automatic Connection	4.6.2.2, 4.6.2.3
Manual Connection	4.6.2.3
Non-delayed Automatic Connection	4.6.2.1
ESSENTIAL ELECTRICAL SYSTEMS-HOSPITALS	4.6
Alternate Source of Power	4.6.3
Critical Branch	4.6.1.2
Distribution Equipment	4.6.4
Essential Electrical System Distribution (Riser Diagram)	1.9(g)(3)
Existing Facilities	4.4
Generator Set Sizing Calculations	1.11(d)
Life Safety Branch	4.6.1.1
Minimum Riser Drawing Requirements	1.9(h)
Scope	1.6
Type 1	4.6
ESSENTIAL ELECTRICAL SYSTEMS-NURSING HOMES AND LIMITED CARE	4.7
Alternate Source of Power	4.7.3
Critical Branch	4.7.2

Life Safety Branch	4.7.1
Type 2	4.7
ESSENTIAL ELECTRICAL SYSTEMS-OTHER FACILITIES	4.9
Boiler Plant	4.9.1
Energy Buildings	4.9.1
Fire Station	4.9.2
ENERGY CENTER	5.1.1.1
ENERGY ROOMS, CRITICAL LOADS	4.6.1.2(g)
ENGINEERING CONTROL CENTER, CRITICAL LOADS	4.6.1.2(y)
EXISTING CONDITIONS	1.7
As-Built	1.7
Conductors	1.15.7
Conduit and Boxes	1.15.6
Continuity of Service	1.15.13
Demolition Drawings	1.15.2
Lighting Fixtures	1.15.9
Panelboards	1.15.10
Requirements for Equipment Replacement	1.15.3, 1.15.4
Site Visit	1.7
Wiring Devices	1.15.8
EXIT SIGNS, LIFE SAFETY BRANCH	4.6.1.1(e)
EYE BANK, CRITICAL LOADS	4.6.1.2(d)
FIRE ALARM SYSTEMS	1.14
General	1.6(f)
Life Safety Branch	4.6.1.1(a)
Riser Diagram	1.9(g)(5)
Smoke Partitions	1.9(i)
Transport Systems	1.13
GENERATORS	
Alternate Sources of Power	4.6.3
Battery Charger, Life Safety Load	4.6.1.1(f)
Emergency-Equipment Loads	4.6.2.1
Generator Set Sizing	1.11(d)
Large-Scale Plans	1.10.1(e)
Location	1.9(d)
Seismic Bracing	1.12
Selected Receptacles, Life Safety Load	4.6.1.1(f)
Sizing – VAMC BMEP STANDARDS	4.2
Task Illumination, Life Safety Load	4.6.1.1(f)
GROUNDING	
Conductor	1.9(e), 2.8
Ground Sensing System for Secondary Breakers	1.9(g)(3)
Metal Curtain Walls	2.8(a)
Seismic Bracing	1.12
HEMODIALYSIS, CRITICAL BRANCH	4.6.1.2(i)
MEDIUM VOLTAGE SWITCHES	
Seismic Bracing	1.12
HUMAN PHYSIOLOGY LABS, CRITICAL BRANCH	4.6.1.2(j)
ILLUMINATION OF MEANS OF EGRESS	4.5.1
Load Type, Life Safety Branch	4.6.1.1(g)

INTENSIVE CARE, CRITICAL BRANCH	4.6.1.2(k)
INTERCOMMUNICATION SYSTEMS	
Cable Trays	7.5
Cellular Floors	7.7
Conduit and Boxes	7.4
Drawings and Details	7.11
Ducts	7.7
Enclosed Cable Trays	7.6
Enclosed Wireways	7.6
General Requirements	7.2
Head End Equipment Room	7.12
Installation Requirements	7.10
Open Wireways	7.5
Special Requirements	7.18(a)
Terminal Cabinets	7.9
Wires and Cables	7.3
ISOLATED POWER SYSTEM	9.2
Conductors	2.7
Critical Branch	4.6.1.2(l)
LAUNDRY BUILDING	
Submetering	5.1.1.1
LABORATORIES	
Critical Branch	4.6.1.2(z)
Large-Scale Plans	1.9(f)
LIGHTING	
Animal Ward	6.19
Ballasts	6.7
Bedrooms	6.11
Calculations	1.11, 6.3
Controls, Exterior	6.10(g)
Controls, Low Voltage	6.10(d), 6.10(e)
Controls, Multi-entrance	6.10(c)
Controls, Multi-level	6.10(a)
Controls, Occupant Sensors	6.10(f)
Corridor – Nursing Homes and Geriatric	6.12
Dental Suite	6.13
Design Approach	6.5
Details	6.4
Exterior	6.23, 6.24, 6.26
Eye Exam Rooms	6.14
Fixtures, Corridor	6.12
Fixtures, Exit	6.8(d)
Fixtures, General	6.8
Fixtures, Labs	6.9(d)
Fixtures, Layout	6.9
Fixtures, Multi-lamp	6.8(c)
Fixtures, Pharmacy	6.9(d)
Fixtures, Shops	6.9(d)
Fixtures, Storage	6.9(f)

Fixtures, Toilets	6.9(e)
General	6.1
Hemodialysis	6.15
Interstitial Space	6.16
Kitchen Hood	6.17
Light Sources, Fluorescent	6.6.3
Light Sources, HID	6.6.2
Light Sources, Incandescent	6.6.1
Lighting Levels by Space Use	Appendix A,6.27.2
Obstruction	6.25
Parking Garage	6.22
Parking Lot	6.27
Pool	6.18
Seismic Bracing	1.12
Special Areas (Lobbies)	6.5.2
Standards	6.2
Surgery Ward	6.20
Wet and Damp Location	6.21
LIGHTNING PROTECTION	
Code Requirements	1.8
Design Guidelines	1.8
Metal Curtain Walls	2.8(a)
Risk Index	1.8
MASTER TV ANTENNA AND EQUIPMENT SYSTEM	
Cable Trays	7.5
Cellular Floors	7.7
Conduit and Boxes	7.4
Drawings and Details	7.11
Ducts	7.7
Enclosed Cable Trays	7.6
Enclosed Wireways	7.6
General Requirements	7.2
Head End Equipment Room	7.12
Installation Requirements	7.10
Open Wireways	7.5
Special Requirements	7.18 (e)
Terminal Cabinets	7.9
Wires and Cables	7.3
MEDICAL GAS ALARM SYSTEM	9.9
Life Safety Branch	4.6.1.1(a)
MEDICATION PREP ROOMS, CRITICAL BRANCH	4.7.2(b)
METAL CURTAIN WALLS	
Grounding	2.8(a)
Lightning Protection System	2.8(a)(5)
MINOR OPERATING ROOM, CRITICAL BRANCH	4.6.1.2(n)
MOTION INTRUSION DETECTION	
Cable Trays	7.5
Cellular Floors	7.7
Conduit and Boxes	7.4

Drawings and Details	7.11
Ducts	7.7
Enclosed Cable Tray	7.6
Enclosed Wireway	7.6
General Requirements	7.2
Head End Equipment Room	7.12
Installation Requirements	7.10
Open Wireways	7.5
Special Requirements	7.18(f)
Terminal Cabinets	7.9
Wires and Cables	7.3
MOTOR CONTROL CENTERS	
Location	1.9(d)
Schedules	1.9(c)
Seismic Bracing	1.12
MOTORS	
Disconnect Switches	2.9
Rating	1.9(b)
MOTOR STARTERS	
Seismic Bracing	1.12
NURSES STATION, CRITICAL BRANCH	4.6.1.2(p)
NURSE CALL	
Equipment, Critical Branch	4.6.1.2(s)
General	1.6(f)
Riser	1.9(g)(6)
Seismic Bracing	1.12
OPERATING ROOMS, HUMAN	
Isolated Power Systems	5.3.2
OPERATING ROOMS, ANIMAL	5.3.3
OPERATING ROOMS, HUMAN – SURGICAL LASER	5.3.4
OXYGEN STORAGE PAD CONTROL PANEL	3.4.33
PANELBOARDS	
Schedules	1.9(c)
Seismic Bracing	1.12
PATIENT ANNUNCIATION SYSTEMS	
Cable Trays	7.5
Cellular Floors	7.7
Conduit and Boxes	7.4
Drawings and Details	7.11
Ducts	7.7
Enclosed Cable Trays	7.6
Enclosed Wireways	7.6
General Requirements	7.2
Head End Equipment Room	7.12
Installation Requirements	7.10
Open Wireways	7.5
Terminal Cabinets	7.9
Wires and Cables	7.3
PATIENT BEDROOMS, CRITICAL BRANCH	4.6.1.2(h)

PATIENT WALL SYSTEMS	9.4
Seismic Bracing	1.12
PATIENT MONITORING SYSTEM	2.6
PBPU (Prefabricated Bedside Patient Unit)	
Application	9.7
Definition	4.5.2
General	9.5
Installation	9.6
PHARMACY DISPENSING AREA, CRITICAL BRANCH	4.6.1.2(q)
PHARMACY DELIVERY SYSTEM, CRITICAL BRANCH	4.6.1.2(aa)
POKE-THRUS/ POWER POLES	2.5
POWER POLES	2.5
PROPRIETARY ITEMS	1.10.4
PSYCHIATRIC BEDROOMS, CRITICAL BRANCH	4.6.1.2(r)
PUBLIC ADDRESS	7.1(j)
Cable Trays	7.5
Cellular Floors	7.7
Conduit and Boxes	7.4
Drawings and Details	7.11
Ducts	7.7
Enclosed Cable Trays	7.6
Enclosed Wireways	7.6
General Installation Requirements	7.10
General Requirements	7.2
Head End Equipment Room	7.12
Open Wireways	7.5
Speaker Locations	7.18(a) Terminal
Cabinets	7.9
Wires and Cables	7.3
RADIOLOGY	
Large-Scale Plans	1.9(f)
RADIO ENTERTAINMENT DISTRIBUTION SYSTEM	
Cable Trays	7.5
Cellular Floors	7.7
Conduit and Boxes	7.4
Drawings and Details	7.11
Ducts	7.7
Enclosed Cable Trays	7.6
Enclosed Wireways	7.6
General Installation Requirements	7.10
General Requirements	7.2
Head End Equipment Room	7.12
Open Wireways	7.5
Speakers	7.18(d) Terminal
Cabinets	7.9
Wires and Cables	7.3
RADIO PAGING SYSTEM	
Cable Trays	7.5
Cellular Floors	7.7

Conduit and Boxes	7.4	
Drawings and Details	7.11	
Ducts	7.7	
Enclosed Cable Trays	7.6	
Enclosed Wireways	7.6	
General Requirements	7.2	
Head End Equipment Room	7.12	
Installation Requirements	7.10	
Open Wireways	7.5	
Terminal Cabinets	7.9	
Wires and Cables	7.3	
RECEPTACLES	1.6(i)	
Administrative Areas	3.4.22	
Animal Surgery	3.4.10	
Animal Wards – GFCI Receptacle	3.4.17	
Bed Motor (PBPU)	3.4.14	
Clinical Exam	3.4.22	
Cooling Tower	3.4.11	
Corridor Receptacles	3.4.19	
Cystoscopy and Minor Surgery	3.4.3(c)	
Dental Module Receptacle	3.4.15	
Electrical Closet	3.4.29	
Emergency Circuit	3.4.2	
Exterior	3.4.5	General
Exam	3.4.22	
General Surgery Rooms	3.4.3(b)	
Ground Fault Interrupter	3.4.1	
Hemodialysis	3.4.6	
Hubbard Tanks	3.4.7	
ICU-CCU	3.4.4	
Interstitial	3.4.27	
Isolated Ground	3.1	
Kitchen	3.4.21	
Laboratory	3.4.23	
Large Surgery Rooms	3.4.3(a)	
Maximum Receptacles Per Circuit	3.3(a)	
Motorized Treadmill Receptacle	3.4.31	
Office	3.4.22	
Operating Room Computer Terminal	3.4.32	
Outdoor	3.4.5	
Oxygen Storage Pad Control Panel	3.4.33	
Pharmacy Service, Computer System	3.4.8	
Psychiatric	3.4.25	
Rehabilitation Medical Service	3.4.24	
Research Lab	3.4.23	
Research Labs – Electronic Equipment	3.4.16	
Safety	3.1	
Self-illuminated Emergency Receptacle	3.4.12	
Sound Retardant	3.5	

Special Procedures Room, Isolated Power	3.4.13
Stairwell	3.4.26
Surgery Room Laser Receptacle	3.4.18
Telecommunications Closets	3.4.30
TV Power	3.4.28
SECURITY	
Critical Branch	4.6.1.2(cc)
SECURITY CAMERA SYSTEMS	7.1(n)
Cable Trays	7.5
Cellular Floors	7.7
Conduit and Boxes	7.4
Drawings and Details	7.11
Ducts	7.7
Enclosed Cable Trays	7.6
Enclosed Wireways	7.6
General Requirements	7.2
Head End Equipment Room	7.12
Installation Requirements	7.10
Open Wireways	7.5
Terminal Cabinets	7.9
Wires and Cables	7.3
SECURITY MANAGEMENT SYSTEM	
Cable Trays	7.5
Cellular Floors	7.7
Conduit and Boxes	7.4
Drawings and Details	7.11
Ducts	7.7
Enclosed Cable Trays	7.6
Enclosed Wireways	7.6
General Requirements	7.2
Head End Equipment Room	7.12
Installation Requirements	7.10
Open Wireways	7.5
Terminal Cabinets	7.9
Wires and Cables	7.3
SEISMIC BRACING	
CD-54	1.12
Details	1.12.2
List of Equipment to be Braced	1.12.3
Seismic Bracing Calculations	1.11(f)
Specification Section	1.12.1
SELECTED RECEPTACLES	
Definition	4.5.3
SPECIAL PROCEDURE ROOM, CRITICAL BRANCH	4.6.1.2(dd)
SUBMETERING	
Boiler Plant	5.1.1.1(a)
Chiller building	5.1.1.1(a)
Energy Center	5.1.1.1
Laundry Building	5.1.1.1
New Separate Buildings	5.1.2

SURGICAL ROOMS	
Large-scale plans	1.9(f)
Operating Suite, Critical Branch	4.6.1.2(s)
Recovery Room, Critical Branch	4.6.1.2(t)
SMOKE PARTIONS	
See "Fire Alarm"	
SPECIFICATIONS	1.9(j)
Drawing coordination	1.9(j)(2)
Editing	1.9(j)(1)
New Sections	1.9(j)(3)
STAT	
Definition	4.5.4
SWITCHGEAR	
Large-scale Plans	1.10.1(e)
Location	1.9(d)
Schedule	1.9(c)
Seismic Bracing	1.12
TASK ILLUMINATION	
Definition	4.5.5
TELEPHONE/DATA/TELECOMMUNICATIONS	
Basement	8.13
Cable Trays	8.4
Cellular Floors	8.6
Closets	8.15, 8.17
Closets, Design Requirements	1.9(a)
Closets, Installation	7.10
Conduits and Boxes	8.3
Critical Branch	4.6.1.2(u)
Details	8.9
Enclosed Cable Trays	8.5
Enclosed Wireways	8.5
Equipment Room	8.10
General Installation	8.8
Life Safety Branch	4.6.1.1(c)
Open Wireways	8.4
Outlets	8.7
Riser	1.9(g)(6)
Scope	1.6
Scope	8.1
Security	8.12
Seismic Bracing	1.12
Telephone Console Room	8.14
Terminal Cabinets	8.8
Wires and Cables	8.2
TISSUE BANK, CRITICAL LOADS	4.6.1.2(d)
TRANSFORMERS	
Large-scale Plans	1.10.1(e)
Location	1.9(d)
Oil filled Transformer Rooms	5.2.4(d)
Seismic Bracing	1.12

TRANSPORT SYSTEM (ELEVATOR, ETC)	
Fire Alarm Connection	1.13(b)
General	1.13(a)
UNDERFLOOR DUCT SYSTEM	2.4
UNIT SUBSTATIONS	
Seismic Bracing	1.12
VACUUM ALARM SYSTEM	9.9
WARD TREATMENT, CRITICAL BRANCH	4.6.1.2(v)